Railway Mechanical Engineer

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Railway Mechanical Engineer

CONTENTS FOR JANUARY, 1918

Hon. William G. McAdoo

Secretary of the Treasury and Now Also Director General of Railroads

THE DUTY OF THE RAILWAY MAN

You Are Now Working for the Government.

You Have Been Drafted Into the Service of Your Country.

By Proclamation, President Wilson Has Taken Over the Railroads that Our Country Might Better Do Its Part in the War.

As You Owe Allegiance to Your Country You Now Owe Allegiance to Your Job.

Your New Chief—Director-General McAdoo—Wants Your Help. He Needs You. Give Him the Best that Is in You. Stick to Your Work and Do It Right. Read His Appeal to You:

"THIS is a time of great stress, and the attitude of every employee should be determined by the supreme need of the hour—duty to his country first of all. I cannot state too strongly the necessity for devoted and loyal service by every man in this emergency. Every railroad employee is now in effect a government employee and as much in duty bound to give his best service to his country as if he wore the uniform of the United States army and occupied the trenches at the front. Every unnecessary delay in a train movement vitally affects our soldiers and sailors and seriously impairs our ability to defend our rights and our liberties. Every man whose neglect or indifference causes such delays may be responsible for the loss of the son of some noble American mother or father. It is as serious to the country for an employee to be a slacker in his work as for a man to be a slacker in the army.

"The present serious congestion and actual suffering for the want of coal and other supplies will be greatly improved and may be entirely remedied if every employee will do his utmost in his individual task. In the name of patriotism, therefore, for the protection of our sons abroad and for the safety of the nation, I hope that every man, wherever placed, will do his level best. Let us who stay at home be ashamed not to be willing to make sacrifices equally as great as those our gallant sons are already making for us on the bloody fields of France."

If You Never Appreciated the Importance of Your Position in This World Struggle, You Should at This Time.

You Are the Men Behind the Men Behind the Guns. *Back Them Up.* Show Your Mettle as They Are Showing Theirs.

They Depend Upon You.

The Country Depends Upon You.

The Allies Depend Upon You.

The World Depends Upon You.

DO YOUR BIT AND DO IT WELL!

FEDERAL CONTROL OF THE RAILWAYS

Honorable William G. McAdoo Made Director-General; Requests Full Support of Railway Men

THE past few weeks have been full of interest to all railway men. On December 26 President Wilson issued a proclamation taking over the possession and operation of the railways of the United States—"It is necessary for the complete mobilization of our resources that the transportation systems of the country should be organized and employed under a single authority and a simplified method of co-ordination, which have not been proved possible under private management and control," he said.

Hon. William G. McAdoo, Secretary of the Treasury, was appointed director-general and took control of the roads at noon, December 28. He is to be assisted in his gigantic task by a committee of advisors or cabinet made up of J. S. Williams, controller of the currency and formerly president of the Seaboard Air Line; Hale Holden, president of the Chicago, Burlington & Quincy, and a member of the former Railroads' War Board; Henry Walters, chairman of the Atlantic Coast Line; Edward Chambers, vice-president of the Atchison, Topeka & Santa Fe, and Walker D. Hines, chairman of the executive committee of the Atchison, Topeka & Santa Fe. A. H. Smith, president of the New York Central, was appointed temporary assistant to the director-general.

In his first order Director-General McAdoo outlined the status of the employees and the railroads. He said:

"All officers, agents and employees of transportation systems may continue in the performance of their present regular duties, reporting to the same officers as heretofore and on the same terms of employment.

"Any officer, agent or employee desiring to retire from his employment shall give the usual and seasonable notice to the proper officer, to the end that there may be no interruption or impairment of the transportation service required for the successful conduct of the war and the needs of general commerce.

"All transportation systems covered by proclamation and order shall be operated as a national system of transportation, the common and national needs being in all instances held paramount to any actual or supposed corporate advantage. All terminals, ports, locomotives, rolling stock and other transportation facilities are to be fully utilized to carry out this purpose without regard to ownership."

The railroads will continue to be operated directly by their own officers except and until the director-general shall find occasion to order a change. They will be given "a square deal," he has promised, and every opportunity to make good, with such help as the Government can give them and under the presumption that they will not be disturbed except for good cause. Of course, the director-general's power is paramount, but his authority is superimposed upon that of the existing organizations and not substituted for it. His purpose is to secure the greatest possible efficiency from the use of the existing instrumentalities of the railroads, and he believes that with the individual interests of the railroad companies absolutely submerged by the Government guarantee it will be possible to work out many plans for co-ordinating their facilities which have been impracticable for the railroads under the prohibition of the laws and under the pressure of their individual interests.

On Monday, January 8, the director-general issued the following appeal to all railroad employees with the request that it be posted by all railroads:

"The Government of the United States having assumed possession and control of the railroads for the period of the present war with Germany, it becomes more than ever obligatory upon every officer and employee of the railroads to apply himself with unreserved energy and unquestioned loyalty to his work.

"The supreme interests of the nation have compelled the drafting of a great army of our best young men and sending them to the bloody fields of France to fight for the lives and liberties of those who stay at home. The sacrifices we are exacting of these noble American boys call to us who stay at home with an irresistible appeal to support them with our most unselfish labor and effort in the work we must do at home, if our armies are to save America from the serious dangers that confront her. Upon the railroads rests a grave responsibility for the success of the war. The railroads cannot be efficiently operated without the whole-hearted and loyal support of every one in the service from the highest to the lowest.

"I earnestly appeal to you to apply yourselves with new devotion and energy to your work, to keep trains moving on schedule time and to meet the demands upon the transportation lines, so that our soldiers and sailors may want for nothing which will enable them to fight the enemy to a standstill and win a glorious victory for united America.

"Every railroad officer and employee is now, in effect, in the service of the United States, and every officer and employee is just as important a factor in winning the war as the men in uniform who are fighting in the trenches.

"I am giving careful consideration to the problems of railroad employees, and every effort will be made to deal with these problems justly and fairly and at the earliest possible moment. There should be a new incentive to every one in railroad service while under government direction to acquit himself with honor and credit to himself and to the country."

CONGESTION INVESTIGATED

On January 1 Commissioner McChord of the Interstate Commerce Commission made an investigation of the congestion of the railways in the east for the director-general. He has received reports from inspectors at the principal terminals which showed that there is a considerable shortage of power on many roads, a shortage of labor and material to repair the cars and locomotives, and that there is a large number of bad order cars. On the lines of the Pennsylvania Lines West at the Conway yard in Pittsburgh, there were reported 1,744 bad order cars out of a total of 6,379 cars on hand. There were 32 locomotives at that terminal, none of which were O. K. for service.

On the Baltimore & Ohio at Philadelphia there were seven B. & O. and one U. S. locomotive frozen, and 15 additional locomotives were out of service for repairs.

The New York, New Haven & Hartford was in the worst condition. On December 31 it was reported that of 1,081 locomotives assigned to various divisions, 303 were in shop for repairs. Power is needed badly. There is a shortage of material for repairs. It was also reported that locomotives were leaving terminals without proper repairs, causing delays en route. Of 60 locomotives assigned to road freight service on the Hartford division, 22 were in shops.

The locomotive situation in the east is relieved somewhat, as now the Russian orders are being held back and 90 to 100 of the Russian engines have been taken for use here as well as about 100 locomotives built for General Pershing's army which could be spared for a time. Also 165 locomotives which were for the western lines are to remain in the east.

INCREASE LOCOMOTIVE OPERATING EFFICIENCY

BY

CLEMENT F. STREET

DURING the past ten years more improvements have been made in the locomotives in use on the railroads of this country than in any other equal period since the first locomotive was built. The most radical have been in the dimensions and power, and to-day there are hundreds of them in service which ten years ago would have been thought entirely impractical, if not impossible, from either standpoint. Many important improvements have also been made in designs as well as in the way of attachments and appliances for increasing their efficiency, and today they are producing a horsepower at the drawbar at a cost in pounds of coal which ten years ago would have been considered impossible of attainment. The end is not yet, and while ten, and even twenty, years ago we would frequently hear that the maximum had been reached in both power and efficiency, today we seldom hear such a remark, and many promising improvements are under way.

We have been reading and hearing much about all of these things, but we read and hear very little about the improvements which have been, and are, being made in the operation of locomotives, with a view of increasing their earnings. It is the purpose of this article to treat with some features of this subject.

A locomotive is the only thing on a railroad which earns money. When the locomotives on a railroad are working to their maximum capacity, both in tonnage hauled and time pulling trains, the earnings of that road are at their maximum. Consequently, the primary efforts of railway operating officers are constantly being directed to the problem of loading locomotives to full capacity and keeping them moving.

TO GET THE BEST efficiency from a locomotive it must be properly maintained. This means that there must be adequate repair facilities at engine houses. This is axiomatic, yet there are many, many cases where the engine house facilities have been almost entirely ignored. Anything *was* good enough for the engine house. Today the railways, through the shortage of power, are finding how necessary well equipped and well organized engine house forces really are. In the future, if the lesson is properly learned, there will be nothing too good for the engine house.

New power has not been obtained on account of the price and the scarcity of materials. The existing power must be worked to the limit of capacity. Improvements that will increase the operating efficiency of locomotives should and must be made. They are necessary in the interests of the welfare of the nation.

THE ENGINE HOUSE

The engine house comes very near being the key to the whole question of locomotive earnings. The best designed, best built and best operated locomotives in existence will not make a good record unless they are backed up by a good engine house, and poor locomotives, with the backing of a good engine house will make a better showing than good locomotives with a poor engine house.

It has, for many years, and in all lines of manufacture, been well understood that it pays to give workmen a comfortable place in which to work, and good tools to work with, and railroad managers recognize the fact that this applies to an engine house. As a result, the design and layout of modern engine houses has been given careful study by competent engineers, and they are just as great an improvement over the old ones as the modern locomotives are over the old locomotives. The question of their location has been given careful study, and they are so placed as to cause the least loss of time in locomotive turnings. They are of concrete, or other fireproof material, with many windows of large dimensions, which give good daylight; they have well-laid floors, which can be kept dry and clean with little trouble; they have good heating and electric lighting systems, and also equipment for washing out boilers with hot water; they have a machine shop under the same roof—not a half mile away—and this shop has a full equipment of all the tools required for making the regular engine house repairs. A storehouse is also under the same roof, from which all supplies can be drawn for both repairs and running. The

oil house is located just as near as it is safe to locate it, and a regular man in charge saves time and waste in promptly dealing out supplies, and also reduces fire risk. With good equipment, such as this, good results are being obtained.

On the other hand, many old engine houses are still in existence—dismal buildings—where we see men groping around in the dark, without adequate heating, lighting, or ventilating systems, wading through water, mud and ashes, at long distances from machine tools and supplies, and the only wonder is that they do as well as they do. The latter conditions do not exist by choice, but by necessity, and where we do find them, we also find that the road maintaining them does not have the money with which to make necessary improvements. The day in which anything was considered good enough for an engine house has gone.

Engine house supervision is being given attention because it also is of vital importance. In fact, it is fully as important as good buildings and equipment, for the reason that the saying that "a good workman with poor tools will produce better results than will a poor workman with good tools," will apply to an engine house. The job of the engine house foreman is not much sought after, and this is not as it should be, as it affords an unusual opportunity for a man to show his real ability. Any man who can make an unqualified success as an engine-house foreman is fully equipped for the next step in advance to the position of master mechanic.

The customary, but not universal, practice is to take a shop-man for this job, and preferably one who has had experience as a locomotive engineer, which is all right. Men who have both these qualifications are, however, growing more and more difficult to secure, and it might be found advantageous to institute a regular system of training for the position. Very few men go from the shop to the road, or from the road to the shop. If it was more generally understood that men who did do this would be the first to have consideration for advancement, more of them would do it, and the result would be that the railroads would have a larger number of men from which to make selections for this position.

The engine house has much to do with locomotive mileage between shoppings. By "babying" a machine, and giving it an elaborate and expensive supervision, it is possible to bring this up to unusual figures. A sample of what can be done along this line is in the records of the Chicago, Milwaukee & St. Paul. A 16 in. by 24 in. eight-wheel locomotive was built at the West Milwaukee shops, and placed in service in October, 1889. It was not taken in the shops for general repairs until October, 1893, a period of four years, and during this time the engine made an aggregate of 224,907 miles, or an average of nearly 4,700 miles per month. Of course, a great many running repairs were made, such as tire changing, renewal of driving-box brasses, etc., at the engine house. During this period, the locomotive received the best care it was possible to give it. It was on a regular run, in charge of a regular crew on a long run, and was "babied" to an extent which would hardly seem to be practical in regular operation. This is one instance, and is merely an example of what can be done when every possible effort is centered on one locomotive.

LOCOMOTIVE MILEAGE

It used to be quite generally accepted that one hundred miles was a day's run for a locomotive, and that after making this mileage it must go to the engine house. It has, however, for many years been understood that this was not the best practice, and that a greater mileage than this should be made. As far back as 1888, J. H. Setchel, in his presidential address to the Railway Master Mechanics' Association, said: "Locomotives should wear out and not rust out, and when this is properly understood and acted on, locomotives will run six and eight thousand miles per month, where they now run three or four at the most." The truth of this statement was generally understood at that time, and has never been challenged. While the subject has been many times discussed, all of the discussion has been regarding the best means for accomplishing an end, the desirability of which was a foregone conclusion.

So far as the locomotive as a machine is concerned, a run of one hundred miles (barring delays) is not much more than a good warming up, and there is no reason why it should not run three hundred or four hundred miles a day. The arrangement of crews is another question, and also that of turning points and terminals. A practical and advantageous solution of both of these is beset with troublesome and annoying problems, but none of them are insurmountable, and they have been, and are being, solved. As a result, we have locomotives regularly assigned to runs aggregating three hundred and four hundred miles per day in freight service. In order to make this mileage, a locomotive cannot be held on side tracks, but must be kept moving. Right here is where another great advance has been made in railroad operation. The stopping and holding of a freight train for trivial reasons used to be a common occurrence, but this is no longer the case. With double tracks, good signal systems and good despatching, it is possible to run an entire division without stopping, except for water. One of the most wasteful and vicious practices ever instituted on our railroads was the stopping of freight trains for orders, and this is being rapidly relegated to the scrap pile, where it belongs.

The stopping of a five or six thousand ton train without good and sufficient reason is a serious offense against good operation, and it is being looked upon as such and treated accordingly.

A number of years ago I was on a locomotive hauling 4,600 tons when a track foreman held a red flag in front of it, until it came to a dead stop, with the train standing on a curve, and then stepped aside and signaled to go ahead. In trying to start, two drawbars were pulled out, and it was two hours before the train was again under way. By this time three or four additional trains were lined up behind it, and one track of the division was tied up. The trackmen were only leveling up the tracks and tamping ties, and the train could just as well have been allowed to keep moving at a low speed, as there was not the slightest danger of a derailment. These things are now being watched more closely, and this could not occur today.

COAL

There has probably been more said and more written about coal than any other subject in connection with the operation of locomotives, and coal saving has been so well thrashed out that there would seem to be little left to say, but, like the poor, this is always with us, and always will be.

While, from some points of view, we have made wonderful progress in coal saving, from others, we have hardly scratched the surface. One of the latter is in regard to the size, or physical condition of the coal. It was formerly believed that the chemical analysis was the only test, and only two grades as to size were generally used, viz.: run-of-mine and slack. On some roads lump was supplied for passenger runs, but, as a rule, run-of-mine was used. It was also generally believed that there were only two grades of coal as to quality, that is, good coal and poor coal.

Both these beliefs are rapidly being changed, and it is becoming recognized that what is good coal for one locomotive might be poor coal for another, and coal which would result in a locomotive failure on one locomotive would give perfect results on another. There are to-day large numbers of locomotives running and giving excellent results with grades of coal, which, five years ago, were considered so poor as to be useless. This has been accomplished by fitting the

locomotives with appliances specially designed to enable them to burn low grade coal.

The question of the size of coal is of such importance that a committee was appointed by the International Railway Fuel Association to conduct a series of tests, the main object of which was to determine the most desirable size of bituminous coal to use on locomotives. A complete and exhaustive series of tests was made by this committee at the University of Illinois, during which six different sizes of coal were tested. The bituminous coal operators have for some time been grading their produce as to size to a limited extent, and, under normal conditions, this practice will be extended more and more, as it has been found advantageous to both the producer and consumer. The probability is that at no very distant day the grading of bituminous coal as to size will, under normal conditions, be just as complete and just as universal as is the grading of anthracite.

Locomotive coaling plants are now being built to provide for the handling of different sizes of coal, and this practice will, under normal conditions, be extended. This necessitates a more careful supervision of these plants, and the men in charge must be of a higher grade of intelligence than formerly.

Some railroads are using a mixture of anthracite and bituminous coal and formerly they were put on the tanks in alternate layers and the fireman depended upon to see that the mixing was properly completed. This practice is being improved on by the installation of mechanical mixing plants in which the two coals are thoroughly and mechanically mixed in the coaling station and before being put on the tender of the locomotive. The results from this practice have been found to be of sufficient advantage to more than compensate for the slight additional expense.

In fact, it is now well recognized that it is a good investment to go to almost any trouble and expense to see that the coal placed on the tank of a locomotive is of such a character as to preclude any danger of a locomotive delay or failure which the crew could claim was due to the coal.

THE FIREMAN

The instruction of firemen is being given more attention than formerly, as it is well understood that with improper firing, twenty to thirty per cent of the coal is wasted. There are to-day more traveling firemen employed than ever before, and the practice of employing them is being extended, as they are found a good investment, not only because of the saving they make in the coal burned, but also in the reduction in train delays owing to failures for steam due to bad firing. Furthermore, correct firing is essential to a locomotive hauling full tonnage and being worked to full capacity, and a good fireman can be depended on to take 10 to 15 per cent more tons over a division than a poor one.

Correct firing was a hobby of the late C. W. Hayes, superintendent locomotive operation of the Erie Railroad, and while this was pretty generally known, I doubt if the results he obtained from riding this hobby were as well known. From what I saw of the locomotives under his supervision, and from what I learned regarding them from experts in my employ, I formed the opinion that the average of the firing done on them was better than any other I know anything about. As a result of the careful and persistent following up which Mr. Hayes gave this subject, I know that these locomotives were worked more nearly to their full capacity than is usual with hand firing, and I have every reason to believe they were burning less coal in relation to the work done. I have looked in the fireboxes of many locomotives on that road and found many fires which showed clearly that the fireman had been doing a good job. On the other hand I have looked in the fireboxes of locomotives on other roads, some of the officials of which roads were in the habit of using their most patronizing tone of voice when speaking of "The Poor Old Erie," and have found many of them so full of coal and ashes that they would fall out of the fire door when it was opened.

There is probably no other line of work of equal importance where men have the proposition put up to them with as little instruction and preparation as they have when they tackle the job of firing a locomotive, and I doubt if there is any other place on a railroad where more effectual safeguards can be erected against possible waste than can be done by a well organized force of firemen instructors.

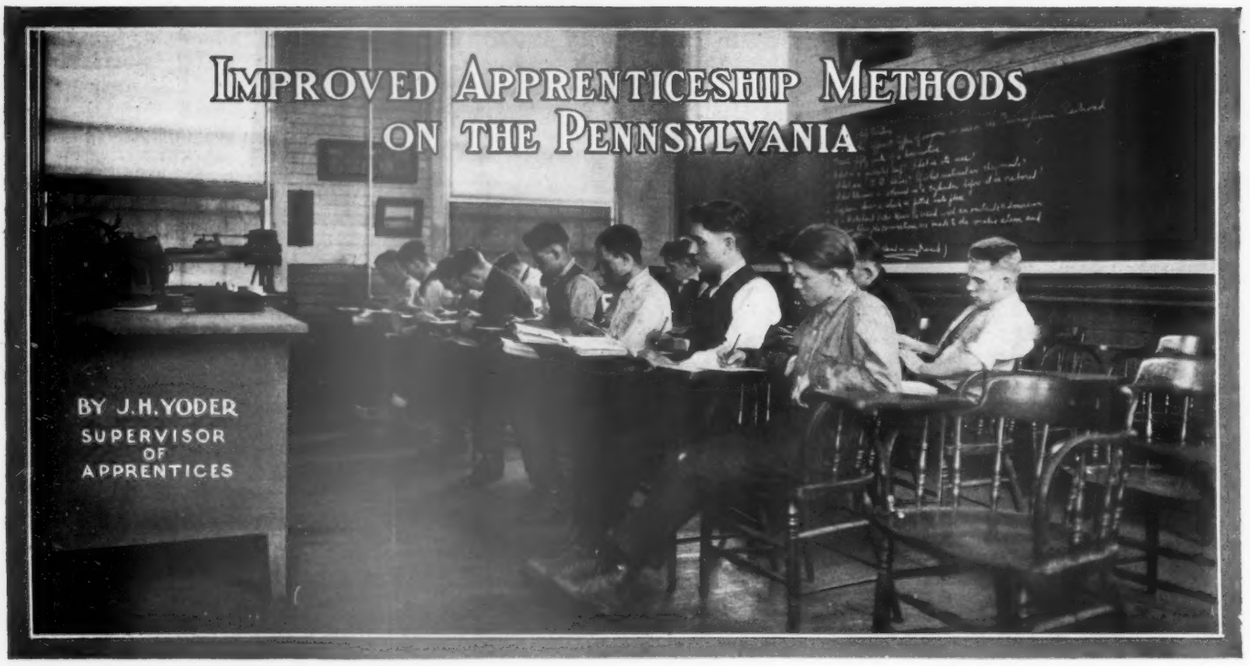
SUMMARY

The railroads of this country have for several years past been showing an increase in net earnings in the face of reductions in rates and increases in operating expenses, and they have been doing this with a regularity and to an extent which has resulted in the belief in many minds that the rates which they have been receiving were too high, and should be even further reduced. If the foregoing statements of what has been, and is being done, are given careful consideration, it will be seen that the good showings which have been made, are the result of the outlay of large sums of money in a carefully analyzed system of improvements for increasing efficiency. The railroads have been buying locomotives of the greatest hauling capacity ever known, and also the most efficient in operation. They have also been furnishing better engine house supervision, increasing locomotive mileage, reducing train delays, using better coal, and giving better supervision to the burning of coal. This is not the entire list by any means, but as a result of these and other things, all with the same object in view, the railroads of the United States have been for many years and are to-day, hauling a ton of freight one mile at a less cost than it ever has been or is being done in any other country in the world, and are carrying passengers at a less cost and in greater comfort than they think of expecting elsewhere.

WATCH THE HIGH WATER MAN

Some locomotive engineers seem possessed to carry the water too high in the boiler. It is a practice that wastes coal and interferes with the proper performance of the locomotive. High water restricts the steam space and gives the steam a much too high degree of priming. It is particularly objectionable on superheater locomotives. If the water level is kept at such a point that water is carried over through the throttle and dry pipe into the superheater, the latter has to turn this water into steam, thus giving up part of its surface for evaporative purposes, and there is a consequent reduction in the amount of superheat obtained and a falling off in the locomotive's performance. The superheater is placed in a locomotive for the purpose of superheating steam, not for evaporating water. The so-called "high water man" should be carefully watched and instructed in carrying the water level at a point as low as possible, consistent with safety. This is a point which should be the subject of constant care and attention on the part of the enginemen and road foremen. If given the attention it deserves, it will bring results which will pay for the time and energy taken to watch it.

PENNSYLVANIA HOLDS FAST TRAIN FOR SICK WATCHMAN.—The Pennsylvania Railroad company showed the human side of the corporation one morning recently when it held up one of its through passenger trains, running as an extra with first class privileges, for half an hour to get a doctor on board who would carry relief to a lone watchman in a little box six miles west of Lewistown Junction, Pa., suffering from an acute attack of cramps. After the doctor had administered first aid to the sick watchman, both were brought to a local hospital in the caboose of a freight train.



IMPROVED APPRENTICESHIP METHODS ON THE PENNSYLVANIA

BY J.H.YODER
SUPERVISOR
OF
APPRENTICES

THE OCCUPATIONS of machinist, boilermaker, blacksmith, etc., which require a high degree of mechanical skill and are necessary in time of peace, become a national asset in time of war. The importance of railway workers trained in these trades, during periods of national emergency, has been demonstrated during the past few months. A statement has been issued by the national government calling attention to the necessity of developing a body of highly trained industrial workers, so that the war may be pushed to a successful conclusion. It is, therefore, imperative that those in charge of training mechanics do not grow lax in their efforts and that the number of apprentices learning trades be kept to the highest possible point consistent with the shop efficiency.

Owing to the scarcity of skilled men at this time there is ample opportunity to place the more advanced apprentices on productive work. This will help the apprentice to develop confidence in himself, and in the meantime increase shop output. Present conditions again demonstrate the lack of a sufficient number of thoroughly trained mechanics. It is unfortunate that it takes times like the present to wake us up to the fact that skilled men are an absolute necessity. Those concerns which have well-established apprenticeship systems have not fared as badly as those which are not so fortunate. However, it is also a fact with those concerns that have a well-established system that apprentices have not always been hired with a definite degree of regularity. In order that apprenticeship be successful and supply the ever-increasing needs for skilled men it is imperative that a definite minimum number of apprentices be hired every month, irrespective of industrial conditions for the time being. In many cases where too few apprentices were hired in the past the result was that at times like the present an insufficient number of graduates are forthcoming.

THE PENNSYLVANIA Railroad has always given much attention to the training of its employees in the mechanical department. There has possibly been, however, too great an emphasis placed on the training of college men for the more important positions and too large a gap between the regular and the special apprentices. Mr. Yoder sketches the latest developments in the apprenticeship course from which it appears that this gap has been filled and that it is now possible for the regular apprentice to go as high as his abilities and energy will permit. Indeed, regular apprentices are encouraged to qualify for the more important positions.

The wisdom of modern apprenticeship methods advocated by such men as Basford, Cross and Thomas is being emphasized in the present emergency and it is to be hoped that the railroads will awaken to the absolute necessity of adopting such methods.

Much has already been written about apprenticeship but present conditions, due to the war, demand with increasing importance that the mechanical department of the railroad have a well-established apprenticeship system which provides:

First—The training of competent skilled and intelligent mechanics.

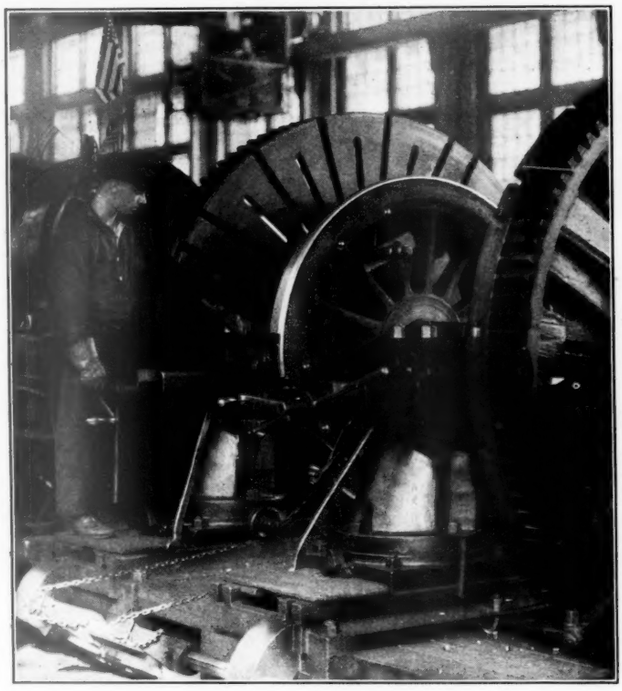
Second—The training of men for minor executive positions.

Third—The training of men, who are college graduates, for executive positions requiring an engineering education.

Fourth—School instruction co-incident with the work being done by the apprentices in the shop.

With the above objects in view, there are established on the Pennsylvania Railroad three grades of apprentices; namely, *Regular, First-class* and *Special.* The regular apprentices comprise the major part of the apprentices em-

ployed. These graduate as mechanics and are given employment in the shops and engine houses. It is toward this class that the main effort is directed. The training is such as to embody every phase of shop work encountered in building or repairing railway equipment. At the end of the



Third Year Apprentice Turning Tires in the Wheel Shop

four-year training they are highly skilled mechanics and can follow successfully any one of a number of activities.

First-class apprentices are appointed from regular apprentices after serving three years. They win this recognition through diligent application in both the shops and school and after having demonstrated their fitness to be advanced to the highest standing. Apprentices from all shops have opportunity to become first-class apprentices. If appointed to this advanced standing they must be transferred to Altoona, since all first-class apprentices are trained at these shops. The schedule embodies a wide range of all phases of railroad work which fits the first-class apprentice to occupy positions of minor responsibility and leadership upon the completion of his course. Many are appointed to important positions after proving themselves worthy and competent, and are in line for further advancement. *As a prize to the best and most capable, one first-class apprentice each year is advanced to the grade of motive power inspector and placed on the same standing as graduate special apprentices.* This means that if those so appointed continue to develop, they will be in line for promotion to the higher positions the same as graduate special apprentices.

Special apprentices are graduates of recognized technical colleges or universities who serve three years at the Altoona shops. The greater part of the time is devoted to intensive training in all phases of shop work, including car building and repairing, enginehouse work, and locomotive firing. The aim is not to develop skill and mechanical dexterity, but to give a general insight into shop conditions, locomotive operation, etc., so that as higher officials these men will be able to make judicious decisions on important work that may come before them as executives. It is unfortunate though that there are so few special apprentices at this time due to the unprecedented demand for college trained men. This condition makes it imperative that the standard of the other grades be raised to fill this gap. It is encouraging to note too that the first-class apprentices are being used in many cases where special apprentices were formerly employed.

APPRENTICE SCHOOL

Perhaps no other factor has had a greater influence in improving the apprenticeship system than the establishment, by the company, of its apprentice schools. An experimental school was established in February, 1910, by having two instructors from the Pennsylvania State College conduct a class consisting of thirty selected apprentices. This class met twice a week for two hours each period and proved to be such a success that in the following September two instructors were employed by the company and placed on the rolls of the superintendent of motive power, Eastern Pennsylvania division.

The enrollment at the beginning of the first school year was 180 while in July of the following year this number had increased to 277. The development has since been rapid and within the last two years the instruction system has been extended to include all shops on the Lines East. There are now eleven schools, and apprentices at all shops receive practically the same training. The largest school is at Altoona, where 235 apprentices are now enrolled. In these schools apprentices are given a thorough training in the underlying physical and mathematical principles of their respective trades. The object is to give regular and first-class apprentices the benefit of education and thereby make them of more value to themselves and more efficient workmen.

The subjects taught unfold reasons for things done in the shops, the school and shop work being closely coordinated. Problems are given which require shop experience to be answered intelligently. In this way habits of observation are early acquired and the apprentice learns to analyze difficult situations and arrive at a proper solution of his problems. In addition a thorough grounding in practical mathematics and mechanics is included in the school course. The problems given are practical, and whenever possible are made

Third Year Apprentice Working in Link Gang

to apply to some phase of work which may come under the immediate observation of the apprentice. The texts used are especially adapted for instruction in Pennsylvania Railroad standards and methods. The instruction given covers

problems dealing with locomotives, cars, machine tools, screw jacks, blocks and tackle, thread cutting, gears, belts and pulleys, cutting speeds of tools, etc.

The apprentices who are more proficient and advanced in their studies are given courses in locomotive valves and valve gears, valve setting, materials of construction, strength of materials, locomotive boiler construction and operation, and in many cases applied elementary electricity. This work is arranged so that apprentices who have had a good schooling and those with initiative can advance to the higher sections early in their apprenticeship, and thereby obtain more of the advanced subjects and have greater opportunities to earn recognition as first-class apprentices. With this course of instruction apprentices become familiar with the underlying principles of their trade and receive the mental training to develop right methods of thinking. The apprentice school is making it possible for graduate first-class apprentices to be used to good advantage where formerly only special apprentices were employed. It also enables graduate regular apprentices to qualify for important positions in time to come.

Advanced Section Receiving Instructions In Mechanical Drawing, Shop Sketching, etc.

SHOP FOREMAN OF APPRENTICES

The successful operation of any apprentice system depends on the apprentice being given the right kind of instruction in the shop. In order to see that apprentices follow definite shop schedules and are given the right kind of work, the position of shop foreman of apprentices was established. This official is responsible for the proper observance of the shop schedules. He reports to the supervisor of apprentices, cooperates with the shop officials and sees that the proper instruction is given apprentices in the shop. He assists in placing the apprentice, after graduation, on work suitable to his ability. At Altoona shops he is assisted by the shop instructor. Many difficulties which the new boy assigned to a machine meets with are thus smoothed out and the output is kept at the highest point from the very beginning. The work of these men has increased materially the general interest and enthusiasm of the apprentice during the short time the plan has been in operation.

Since the establishment of the apprentice schools and closer supervision of the shop work, a decided increase in the interest toward apprenticeship has been shown by the shop officials and the men in the shop. Instead of apprentices being left to drift aimlessly about the shop and pick up a trade as best they can, their energies are now directed along proper lines. Standardized shop schedules are furnished to shop officials for guidance in training apprentices in the various trades, so that all apprentices, no matter where they serve their time, will receive practically the same training. As an aid in a closer supervision of the work pertaining to apprentices, all shop schedules, together with rules and regulations, etc., have been issued by the general superintendent of motive power in the form of standard instructions No. A-1, "Organization and Rules Governing Employment and Training of Apprentices." These instructions tell definitely what each apprentice is to receive, while at the same time they set forth in a concise way what is expected of the individual apprentice.

With the new organization for training apprentices in both the school and the shop, boys entering the shops to learn a trade no longer find themselves part of a vast organization in which they have that feeling of being lost. They are being respected by the shop officials and the men employed and find all amiable and ready to assist them in every way possible. From the fact that apprentices are followed closely in their work, they early realize the advantages of putting forth their best efforts. With the added advantages of winning promotion from regular apprentices to first class, and from first-class apprentices to that of motive power inspector, there is increased incentive to strive for advanced standing. At the same time regular apprentices who have later developed exceptional ability along special lines have been placed in important positions, so that the new apprentice sees a definite future ahead and apprenticeship has become more attractive. As a whole an apprentice finds his four years spent in the shops a source of pleasure, and in years to come will look back to his apprenticeship with a great amount of pride. Apprenticeship has been the making of many a man, and, since the advent of the apprentice school and special shop supervision and instruction, it is believed that, next to a college education, it is the best preparation for a life vocation.

[Mr. Yoder's mention of the co-operation received from Pennsylvania State College is of special interest in conjunction with the article by Professor Arthur J. Wood of that institution, which will be found elsewhere in this issue. Active co-operation of this sort between our railroads and the colleges and universities is to be commended. A most remarkable demonstration of what can be done in this way is the work done by the co-operative engineering courses of the University of Cincinnati under the direction of Dean Schneider. —*Editor.*]

THE RAILROAD "ROLL OF HONOR"

Seventy Thousand Men Have Entered Government Service—20,000 From the Mechanical Department

NEARLY five per cent of all the employees of the railroads in the United States are now in some branch of the army or navy, according to information furnished by the carriers, in answer to inquiries made by the Railway Age. Replies were received from 118 railroads, operating a total of 200,744 miles of line, or about 77 per cent of the entire mileage of the country. These roads reported that 54,375 officers and employees had left their service since the declaration of war to join the military or naval forces of the United States. If the number of men which the remaining railroads of the country have furnished to the government bears the same relation to their mileage as for the roads from which reports were received, the total number of railway men in army and navy is approximately 70,000 or nearly five per cent of all the employees. About 1,800 railroad men have received commissions as officers. More than one-fourth of the total number of men in government service are former employees of the mechanical department. The total number of men from the mechanical department is probably about 20,000.

Railroad men have been called on by the government for special service as have no other classes. Soon after the declaration of war nine railway regiments were organized for service on the roads supplying the American forces in France. Two additional regiments, the 21st Engineers, for light railway construction, and the 35th Engineers, a shop regiment, have been organized at Camp Grant, Rockford, Ill., during the past three months. Still another special military organization recruited from the ranks of the railway employees is the Russian Railway Corps, consisting of 200 officers chosen from the railroads of the Northwest which sailed for Russia this fall, where they were expected to engage in the rehabilitation of the Trans-Siberian railway.

The organization of the railway regiments for service in France and also the Russian Railway Corps, was carried on under the direction of S. M. Felton, president of the Chicago Great Western, who is now director general of railways, with headquarters at Washington. The men chosen for the heads of both these organizations are former officers of the mechanical department.

The highest commission accorded to any railroad man in the government service is held by W. W. Atterbury, vice president of the Pennsylvania Railroad, now Brigadier-General and Director General of American Railways in France. Gen. Atterbury entered railway service in 1886 as an apprentice in the Altoona shops of the Pennsylvania Railroad. He rose to the position of general superintendent of motive power in 1901, was made general manager in 1903 and in 1909 became vice president. Prior to his appointment as the director of the American railways in France, Gen. Atterbury had been active in the work of recruiting the first nine railway regiments.

H. H. Maxfield, superintendent of motive power of the Western Pennsylvania division of the Pennsylvania Railroad, is a lieutenant-colonel with the American Railway forces in France. In addition to these officers, the mechanical department of this road has furnished the military forces of the United States 2 majors and 13 captains.

The railroads of this country have without exception will-

THE AMERICAN RAILROADS may justly feel proud of their record since this country entered the war. Even with the enormous burden placed upon them since war was declared, the carriers have not asked for exemption for their employees, except in special cases, and have performed splendid service for the government. The remarkable work of the engineer regiments recruited from the railroads, is known to all who have read the despatches from the front. It is not unreasonable to expect that many of the railroad men in other branches of the service will make equally brilliant records. Their fellow employees who are left to do their part in winning the war at their regular posts will follow the activities of their companions across the seas with keen interest. The list of mechanical department men who have received commissions, given in the accompanying article, will, therefore, be of special interest.

ingly furnished their full quota of men to the government. Some of the large railroad systems have not been able to furnish statistics showing the number of employees in the government service. The list below gives as complete data as it was possible to secure concerning the men from the mechanical department of the railroads of this country who have received commissions as officers and also the total number of men from all departments who have joined the colors.

Arizona Eastern

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Worcester, H. W.	Draftsman	1st Lieut.	

Employees who received commissions..... 8
Total number of employees in government service..... 87

Atchison, Topeka & Santa Fe

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Chapman, E. E.	Asst. Engr. Tests.	Captain	Ord. Dept.
Grover, C. A.	Mech. Insp.	Captain	Depot Brigade
Jackson, J. R.	Asst. Engr. Tests.	Captain	Ord. Dept.
Peck, H. M.	Machinist	Captain	Infantry
Schuster, G.	Asst. Engr. Tests.	Captain	Ord. Dept.
Bohnstengel, Walter	Asst. Engr. Tests.	1st Lieut.	Ord. Dept.
Hill, W. J.	Master Mechanic.	1st Lieut.	Ry. Engrs.
Miller, H. R.	Mach. Helper	1st Lieut.	National Guard
Reed, D. R.	Material Insp.	1st Lieut.	Ord. Dept.
Robinson, A. W.	Asst., Test Dept.	1st Lieut.	Ord. Dept.
Richter, J. P.	Asst., Test Dept.	1st Lieut.	Aviation Corps
Sanders, E. C.	Asst., Test Dept.	1st Lieut.	Ord. Dept.
Von Blucher, L. F.	R. H. Foreman	1st Lieut.	Ry. Engrs.
Wheeler, G. O.	Fireman	1st Lieut.	Aviation Corps

Employees who received commissions..... 97
Total number of employees in government service..... 3,000

Atlantic Coast Line

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Mapother, Jr., H. H.	Inspector	2nd Lieut.	305th Engrs.
Sanders, W. C.	Draftsman	2nd Lieut.	C. A. C.

Employees who received commissions..... 37
Total number of employees in government service..... 760

Baltimore & Ohio

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
McDonough, J. J.	Asst. Supt. Shops.	Captain	E. O. R. C.
Gaither, H. B.	Gen. Pc. Wk. Insp.	1st Lieut.	Engr. R. C.
McGuire, J. J.	Master Mechanic.	2nd Lieut.	Engr. Corps
Mellon, F. C.	Inspector	2nd Lieut.	Infantry
Offutt, R. J.	Machinist	2nd Lieut.	Engr. Corps

Employees who received commissions..... 69
Total number of employees in government service..... 1,760

Bangor & Aroostook

Total number of employees in government service..... 75

Bessemer & Lake Erie

Total number of employees in government service..... 222

Boston & Albany

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Smith, E. H.	Master Mechanic.	1st Lieut.	Ry. Engrs.

Employees who received commissions..... 6
Total number of employees in government service..... 295

Boston & Maine

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Bradley, Ralph	Insp. Fuel Serv.	Captain	14th Engrs.

Employees who received commissions..... 18
Total number of employees in government service..... 1,201

Buffalo, Rochester & Pittsburgh

Employees who received commissions..... 3
Total number of employees in government service..... 370

Central of Georgia

Total number of employees in government service..... 341

Central of New Jersey

Employees who received commissions..... 5
Total number of employees in government service..... 652

Central Vermont

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Lampman, L. H.	Machinist	Lieut.	Infantry

Employees who received commissions..... 6
Total number of employees in government service..... 70

Chesapeake & Ohio

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Bills, A. C.	Machinist	2nd Lieut.	

Employees who received commissions..... 23
Total number of employees in government service..... 575

Chicago & Alton

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Helwig, A. A.	Trav. Car. For.	Lieut.	Engrs. Corps

Employees who received commissions..... 12
Total number of employees in government service..... 195

Chicago & Eastern Illinois

Employees who received commissions..... 7
Total number of employees in government service..... 274

Chicago & North Western

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Brandt, J. E.	Rd. For. of Eng.	Colonel	126th F. A.
Jensen, G. B.	Fireman	Captain	Truck Co.
Luth, F. L.	Asst. Car For.	Captain	126th F. A.
McMahan, Ray	Fireman	Captain	Field Artillery
La Bru, H.	R. H. For.	1st Lieut.	Russ. Ry. Corps
Lowry, F. H.	Traveling Engr.	1st Lieut.	Russ. Ry. Corps
Miller, F. C.	Traveling Engr.	1st Lieut.	Russ. Ry. Corps
Sanborn, J.	Engr.	1st Lieut.	108th Engrs.
Schultz, E.	Master Mechanic.	1st Lieut.	Ry. Engrs.
Cooley, E. M.	Engr.	2nd Lieut.	Nat'l Guard
Holt, J. W.	Boiler Foreman.	2nd Lieut.	Russ. Ry. Corps
James, W. H.	R. H. For.	2nd Lieut.	Russ. Ry. Corps
Stewart, E. L.	Inspector	2nd Lieut.	Russ. Ry. Corps

Employees who received commissions..... 47
Total number of employees in government service..... 1,573

Chicago, Burlington & Quincy

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Climo, J. C.	Master Mechanic.	Captain	Russ. Ry. Corps
Roach, J. B.	Master Mechanic.	Captain	Russ. Ry. Corps
Woody, A. E.	Test Car For.	Captain	Ord. Dept.
Law, George	Safety Insp.	1st Lieut.	Russ. Ry. Corps
Swartzcope, F. W.	R. H. For.	2nd Lieut.	Russ. Ry. Corps
Waldhaus, A. A.	Asst. R. H. For.	2nd Lieut.	Russ. Ry. Corps

Employees who received commissions..... 32
Total number of employees in government service..... 1,486

Chicago Great Western

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Brunner, E. F.	Machinist	2nd Lieut.	Russ. Ry. Corps
Jones, A. E.	R. H. Foreman.	2nd Lieut.	Russ. Ry. Corps

Employees who received commissions..... 12
Total number of employees in government service..... 306

Chicago, Indianapolis & Louisville

Employees who received commissions..... 4
Total number of employees in government service..... 123

Chicago, Milwaukee & St. Paul

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Buchanan, F.	Trav. Engr.	Captain	Russ. Ry. Corps
Young, A.	Master Mechanic.	Captain	Ry. Engrs.
Lusk, George	Engr.	Lieut.	Russ. Ry. Corps
Merz, A. S.	Engr.	Lieut.	Russ. Ry. Corps

Employees who received commissions..... 34
Total number of employees in government service..... 1,645

Chicago, Rock Island & Pacific

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Eck, P.	Boiler For.	1st Lieut.	Russ. Ry. Corps
Mueller, S.	Foreman	1st Lieut.	3rd Res. Engrs.
Phelan, T. F.	Rd. For. Equip.	1st Lieut.	Russ. Ry. Corps
Reed, C. W.	Rd. For. Equip.	1st Lieut.	Ry. Engineers
Schlemmer, H.	Loco. Engr.	1st Lieut.	National Army
Jones, J. R.	Engr.	2nd Lieut.	Russ. Ry. Corps
Roberts, J. G.	Fuel Inspector	2nd Lieut.	National Army
Tatum, H.	Gen. For.	2nd Lieut.	Russ. Ry. Corps.

Employees who received commissions..... 26
Total number of employees in government service..... 1,457

Chicago, St. Paul, Minneapolis & Omaha

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Burton, W. Y.	Shop For.	Lieut.-Col.	Infantry
Enockson, H. A.	R. H. Foreman.	Captain	Russ. Ry. Corps
Lystad, A.	Tinner	Captain	Infantry
Bronson, H. S.	Draftsman	Lieut.	E. O. R. C.
Copeland, Peter	Engr.	Lieut.	Russ. Ry. Corps
Dietz, Fred A.	Fireman	Lieut.	National Army
Kuhfeld, W. G.	R. H. Foreman	Lieut.	Russ. Ry. Corps
Larson, Chas.	Trav. Engr.	Lieut.	Russ. Ry. Corps
Lyksett, A. J.	Painter	Lieut.	Infantry
Mathews, J. V.	Asst. B. M. For.	Lieut.	Russ. Ry. Corps
Mattison, C. J.	Loco. Engr.	Lieut.	Russ. Ry. Corps
Peters, E. S.	Asst. B. M. For.	Lieut.	Russ. Ry. Corps
Sorenson, C. H.	Machinist	Lieut.	Russ. Ry. Corps
Van Dresar, M. S.	Boilermaker	Lieut.	Russ. Ry. Corps

Employees who received commissions..... 32
Total number of employees in government service..... 371

Cincinnati, Indianapolis & Western

Employees who received commissions..... 1
Total number of employees in government service..... 52

Cincinnati Northern

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Berthold, A.	Roundhouse Man.	1st Lieut.	

Employees who received commissions..... 1
Total number of employees in government service..... 30

Cleveland, Cincinnati, Chicago & St. Louis

Employees who received commissions..... 9
Total number of employees in government service..... 699

Colorado & Southern

Employees who received commissions..... 2
Total number of employees in government service..... 83

Cumberland Valley

Employees who received commissions..... 5
Total number of employees in government service..... 70

Delaware & Hudson

Employees who received commissions..... 10
Total number of employees in government service..... 454

Delaware, Lackawanna & Western

Employees who received commissions..... 2
Total number of employees in government service..... 88

Denver & Rio Grande

Total number of employees in government service..... 249

Elgin, Joliet & Eastern

Total number of employees in government service..... 319

El Paso & Southwestern

Employees who received commissions..... 4
Total number of employees in government service..... 151

Erie

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Thorpe, John	Engr. Tests	Captain	Aviation Corps

Employees who received commissions..... 26
Total number of employees in government service..... 1,375

Great Northern

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Emerson, G. H.	Gen. Mgr.	Colonel	Russ. Ry. Corps
Hawkins, R. B.	Supt. of M. P.	Lieut. Colonel	Russ. Ry. Corps
Benson, J. C.	Mast. Mech.	Captain	Russ. Ry. Corps
Boynton, Robert	Draftsman	2nd Lieut.	Infantry
Kellerman, R. C.	Draftsman	2nd Lieut.	Q. M. Corps
Upton, Wm. B.	Inspector	2nd Lieut.	U. S. R. Corps

Employees who received commissions..... 23

Gulf, Mobile & Northern

Total number of employees in government service..... 67

Illinois Central

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Nash, F. P.	Gen. Foreman	1st Lieut.	Ry. Engrs.
Donker, J. E.	Car Repairer	2nd Lieut.	
Hitton, J. A.	Engine For.	2nd Lieut.	
Kern, J. W., Jr.	Gen. Foreman	2nd Lieut.	

Employees who received commissions..... 57
Total number of employees in government service..... 1,916

International & Great Northern

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Fletcher, H. V.	Draftsman	1st Lieut.	

Employees who received commissions..... 9
Total number of employees in government service..... 162

Kansas City Southern

Total number of employees in government service..... 135

Lake Erie & Western

Employees who received commissions..... 4
Total number of employees in government service..... 133

Long Island

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Foster, F. H.	Gen. Foreman of Substations	Captain	National Army
Mack, J. W.	Subst. Sys. Oper.	Captain	Army
Best, H. S.	Foreman Substation Dept.	Lieutenant	National Army
Dempsey, J. M.	Draftsman	Lieutenant	Navy
Kiely, E. J., Jr.	Elec. Inspector	Lieutenant	Nat'l Army

Employees who received commissions..... 7
Total number of employees in government service..... 279

Los Angeles & Salt Lake

Employees who received commissions..... 8
Total number of employees in government service..... 116

Louisiana Railway & Navigation Company

Total number of employees in government service..... 60

Louisville & Nashville

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Finley, G. S.	Machinist	2nd Lieut.	

Employees who received commissions..... 30
Total number of employees in government service..... 1,410

Maine Central

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Sturgeon, R.	Loco. Engr.	1st Lieut.	Engr. Corps

Employees who received commissions..... 10
Total number of employees in government service..... 252

Michigan Central

Employees who received commissions..... 6
Total number of employees in government service..... 551

Minneapolis & St. Louis

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Rogers, C. B.	R'd Fm. of Eng.	Lieut.	Russ. Ry. Corps

Minneapolis, St. Paul & Sault Ste. Marie

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Casey, J.	Master Mechanic	Captain	
Roberts, F. M.	Trav. Engr.	1st Lieut.	
Bauers, C. A.	R. H. For.	2nd Lieut.	
Greenseth, A. G.	R. H. For.	2nd Lieut.	
Patton, F. S.	Machinist	2nd Lieut.	
Praiss, W. C.	Engineer	2nd Lieut.	

Employees who received commissions..... 14
Total number of employees in government service..... 474

Missouri, Kansas & Texas

Employees who received commissions..... 4
Total number of employees in government service..... 80

Mobile & Ohio

Employees who received commissions..... 10
Total number of employees in government service..... 150

Nashville, Chattanooga & St. Louis

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Law, A. J.	Master Mechanic	Captain	O. R. C.

New York Central

Employees who received commissions..... 6
Total number of employees in government service..... 4,978

New York, Chicago & St. Louis

Employees who received commissions..... 5
Total number of employees in government service..... 176

New York, New Haven & Hartford

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Kearny, P. J.	Elec. Engr.	Captain	Ordnance Dept.
Cole, A. B.	Inspector	1st Lieut.	Army
Burr, C. M.	Road Foreman	2nd Lieut.	14th Engrs.
Fleming, J.	Asst. For. Shops	2nd Lieut.	14th Engrs.

Employees who received commissions..... 26
Total number of employees in government service..... 1,446

New York, Ontario & Western

Employees who received commissions..... 2
Total number of employees in government service..... 128

Norfolk & Western

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Davant, E. T.	Elec. Reprm.	Captain	Infantry
Lewis, E. B.	Engr. Tests	Captain	Artillery
White, O. L.	Furnace Rpm.	Captain	Infantry
Budwell, W.	Foreman	1st Lieut.	35th Engrs.
Joines, Mac	Engineer	2nd Lieut.	Cavalry

Employees who received commissions..... 49
Total number of employees in government service..... 865

Northern Pacific

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Egbers, G. F.	M. M.	Captain	Russ. Ry. Corps
King, B. C.	Boiler Foreman	1st Lieut.	Russ. Ry. Corps
Montgomery, M. S.	Traveling Engn'r.	1st Lieut.	Russ. Ry. Corps
Brown, J. J.	Machinist	2nd Lieut.	Russ. Ry. Corps
Hazzard, G. H.	R. H. Foreman	2nd Lieut.	Russ. Ry. Corps
Niskern, F. M.	R. H. Foreman	2nd Lieut.	Russ. Ry. Corps

Name	Railroad Position	Military Rank	Branch of Service
Paxton, L. A.	R. H. Foreman	2nd Lieut.	Russ. Ry. Corps
Terry, C. L.	Machinist	2nd Lieut.	Russ. Ry. Corps
Vickers, F.	Machinist	2nd Lieut.	Russ. Ry. Corps

Employees who received commissions..... 61
Total number of employees in government service..... 1,638

Northwestern Pacific

Employees who received commissions..... 3
Total number of employees in government service..... 56

Oregon Short Line

Employees who received commissions..... 9
Total number of employees in government service..... 474

Oregon, Washington R. R. & Navigation Co.

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Hess, A. E.	Car Rep. Helper	1st Lieut.	

Employees who received commissions..... 17
Total number of employees in government service..... 294

Pennsylvania System

LINES WEST OF PITTSBURGH.

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Haubrick, R.	Machinist	Captain	Infantry
Brandt, O. H.	Foreman	1st Lieut.	Infantry
Mercer, J. B.	Mach. Helper	1st Lieut.	10th Ohio
Munro, H. H.	Clerk	1st Lieut.	Signal Corps
Wood, L. F.	Frgt. Engineman	1st Lieut.	Field Artillery
Bridges, P. F.	Repairman	2nd Lieut.	Machine Gun Co.
Minick, D. C.	Gang Foreman	2nd Lieut.	19th Engrs.

Total number of employees in government service..... 3,229

PENNSYLVANIA RAILROAD

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Atterbury, W. W.	Vice-Pres.	Brigadier Gen.	D.-G. Am. Rys. F.
Maxfield, H. H.	Supt. Mot. Power	Lieut.-Col.	19th Ry. Engrs.
Barrett, C. D.	Master Mech.	Major	19th Ry. Engrs.
Gaskill, C. S.	Master Mech.	Major	19th Ry. Engrs.
Byron, A. W.	Master Mech.	Captain	Of. Dir.-Gen. Ry.
Dunkel, J. R.	B. M. Helper	Captain	Infantry
Harris, R. H.	Car Repairman	Captain	Cavalry
Hatfield, C. H.	Car Repairman	Captain	Infantry
Huff, G. F.	Asst. Rd. F. of En.	Captain	19th Ry. Engrs.
Kline, B. W.	Electrician	Captain	19th Ry. Engrs.
Lindner, W. C.	Asst. Gen. Formn.	Captain	35th Ry. Engrs.
MacKendrick, R. G.	Draftsman	Captain	108th U. S. F. A.
Moore, J. F.	Fireman	Captain	101st U. S. Cav.
Reynolds, R. H.	Power Plant Engr.	Captain	Infantry
Robbins, F. S.	Asst. Mast. Mech.	Captain	19th Ry. Engrs.
Roberts, C.	Asst. R. F. of E.	Captain	21st Ry. Engrs.
Salter, D. M.	Shop Hand	Captain	110th M. G. Bat.
Smith, R. M.	Asst. R. F. of E.	Captain	35th Ry. Engrs.
Whitman, E. B.	Asst. R. F. of E.	Captain	19th Ry. Engrs.
Barr, P. W.	M. P. Inspector	1st Lieut.	Ord. Dept.
Boffenmeyer, C. G.	Inspector	1st Lieut.	19th Ry. Engrs.
Dickson, Jr., O. S.	Safety Inspector	1st Lieut.	35th Ry. Engrs.
Diehl, J. C.	Chief Draftsman	1st Lieut.	Engrs. O. R. C.
Kiesel, J. H.	Inspector	1st Lieut.	21st Ry. Engrs.
Mallan, T. L.	Foreman	1st Lieut.	19th Ry. Engrs.
Morris, J. M.	Asst. Mast. Mech.	1st Lieut.	21st Ry. Engrs.
Richers, G. J.	Asst. Mast. Mech.	1st Lieut.	15th Ry. Engrs.
Rowan, C. R.	Inspector	1st Lieut.	110th U. S. Inf.
Rudd, W. B.	Asst. R. F of E.	1st Lieut.	19th Ry. Engrs.
Steins, C. K.	Spec. App.	1st Lieut.	19th Ry. Engrs.
Welch, W.	Foreman	1st Lieut.	19th Ry. Engrs.
Wightman, F. A.	Motive Pow. Insp.	1st Lieut.	19th Ry. Engrs.
Woodcock, R.	Asst. Supervisor.	1st Lieut.	111th U. S. Inf.
Bartlett, M. W.	Usher	2nd Lieut.	Off. Res. Corps
Bixler, D. S.	Asst. Inspector	2nd Lieut.	413th Teleg. Bat.
Brewer, P. C.	Asst. Supervisor	2nd Lieut.	Engrs. O. R. C.
Brown, C. G.	Spec. Apprentice	2nd Lieut.	19th Ry. Engrs.
Byron, R. J.	Foreman	2nd Lieut.	35th Ry. Engrs.
Corbin, W. M.	Car Repairman	2nd Lieut.	112th U. S. Inf.
Davis, K. N.	M. P. Inspector	2nd Lieut.	Off. Res. Corps
Fahnestock, M.	M. P. Inspector	2nd Lieut.	19th Ry. Engrs.
Greeley, C. M.	Special App.	2nd Lieut.	21st Ry. Engrs.
Hawkins, A. C.	Apprentice	2nd Lieut.	U. S. Coast Art.
Murray, J. V.	Mach. Helper	2nd Lieut.	Off. Res. Corps
Northrup, C. D.	Fireman	2nd Lieut.	114th U. S. Inf.
Richards, J. S.	Apprentice	2nd Lieut.	311th U. S. Inf.
Schmitt, F. S.	S. H. Attdt.	2nd Lieut.	61st U. S. Inf.
Schwenk, H. R. D.	Car Repairer	2nd Lieut.	314th U. S. Inf.
Sheaffer, J. G.	Spec. Apprentice	2nd Lieut.	19th Ry. Engrs.
Sellman, F. E.	M. P. Inspector	Ensign	U. S. Navy
Spenser, Jr., W.	Inspector	Ensign	U. S. Navy

Employees who received commissions..... 199
Total number of employees in government service..... 5,441

Pere Marquette

Employees who received commissions..... 6
Total number of employees in government service..... 152

Philadelphia & Reading

Employees who received commissions..... 1
Total number of employees in government service..... 1,283

Pittsburgh & Lake Erie

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Watson, J. R.	Inspection Engr.	1st Lieut.	Engrs. O. R. C.

Employees who received commissions..... 3
Total number of employees in government service..... 425

Pittsburgh & Shawmut

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Morgan, Jr., D. C.	Mech. Engr.		Av. Sig. O. R. C.

Employees who received commissions..... 4
Total number of employees in government service..... 23

St. Louis-San Francisco

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Sharpe, S. B.	Hostler	1st Lieut.	Field Artillery
Snow, W. R.	Hostler Helper	2nd Lieut.	Infantry

Employees who received commissions..... 26
Total number of employees in government service..... 744

St. Louis-Southwestern

Employees who received commissions..... 8
Total number of employees in government service..... 251

San Antonio & Aransas Pass

Employees who received commissions..... 8
Total number of employees in government service..... 101

Southern

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Caye, W. C., Jr.	Inspector	Captain	Engr. Corps
Bowling, J. D.	Chemist	2nd Lieut.	Marine Corps

Employees who received commissions..... 53
Total number of employees in government service..... 1,500

Southern Pacific Lines (Texas & Louisiana)

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Janes, S. B.	Fireman	1st Lieut.	U. S. Army

Employees who received commissions..... 19
Total number of employees in government service..... 311

Southern Pacific (Pacific System)

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Babcock, A. H.	Elec. Engr.	Major	U. S. Reserves
Williams, W. O.	Master Mech.	Captain	Russ. Ry. Corps
Cirby, A. A.	Loco. Engr.	1st Lieut.	Russ. Ry. Corps
Rutherford, D. J.	Elec. Engr.	1st Lieut.	
Waddell, H. C.	Loco. Engr.	1st Lieut.	Russ. Ry. Corps
Jones, A. E.	R. H. Foreman	2nd Lieut.	Russ. Ry. Corps
Wright, G. I.	Elec. Eng.	Lieutenant	U. S. Navy
Houghton, J. W.	Ch. Eng. Pow. Plt.	Lieutenant	U. S. Navy
Hart, J. P.	Elec. Eng.	Ensign	U. S. Navy

Employees who received commissions..... 66
Total number of employees in government service..... 1,874

Spokane, Portland & Seattle

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Bornick, H. A.	Trav. Engr.	Lieutenant	Russ. Ry. Corps
Fischer, B. F.	Boiler For.	Lieutenant	Russ. Ry. Corps
West, J.	Engineman		Russ. Ry. Corps

Employees who received commissions..... 8
Total number of employees in government service..... 101

Tennessee Central

Total number of employees in government service..... 73

Toledo, St. Louis & Western

Employees who received commissions..... 2
Total number of employees in government service..... 60

Union Pacific

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
McClintock, H. E.	Draftsman	Captain	Engineer Corps
McCabe, A. R.	Foreman	1st Lieut.	Russ. Ry. Corps
Reid, M. B.	Motorman	1st Lieut.	Engr. Corps

Employees who received commissions..... 22
Total number of employees in government service..... 1,240

Wabash

MECHANICAL DEPARTMENT EMPLOYEES WHO RECEIVED COMMISSIONS

Name	Railroad Position	Military Rank	Branch of Service
Bennett, H. M.	Loco. Fireman	Captain	
Dixon, E. A.	Asst. Boiler For.	1st Lieut.	Russ. Ry. Corps
Sullivan, J. J.	Machinist	2nd Lieut.	335th Infantry

Employees who received commissions..... 12
Total number of employees in government service..... 460

Western Maryland

Total number of employees in government service..... 108

Western Pacific

Total number of employees in government service..... 143

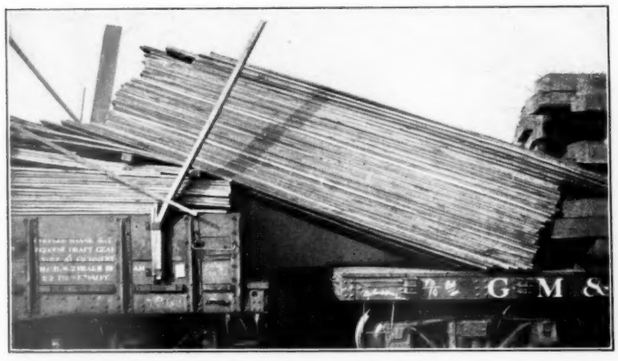
Wheeling & Lake Erie

Total number of employees in government service..... 138

THE IMPROPER LOADING OF LUMBER

Where Open Top Cars are Used for This Purpose Care Must be Taken to Prevent Lading from Shifting

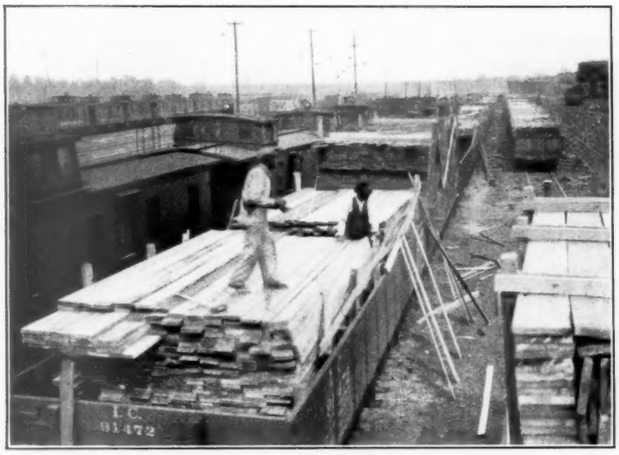
THE unprecedented measures restricting the use of open cars which have been taken by Judge Lovett, director of priority, show the importance of securing the maximum service from this class of equipment. The tonnage of coal that will have to be moved this winter will break all records and the demand for cars will be greater than



Good Judgment or Good Luck in Making Up the Train

the supply. Gondola cars will, therefore, be urgently needed for carrying coal. On the back haul to the coal mining regions gondolas are used for many commodities, one of the most important being lumber. It is the purpose of this article to show how greater service can be secured from open cars by better methods of loading lumber, when transported in that class of equipment.

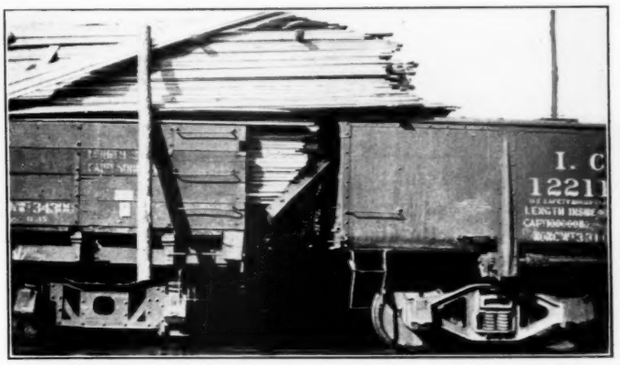
The loading rules of the M. C. B. Association, in brief,



The Transfer Track Is a Busy Place

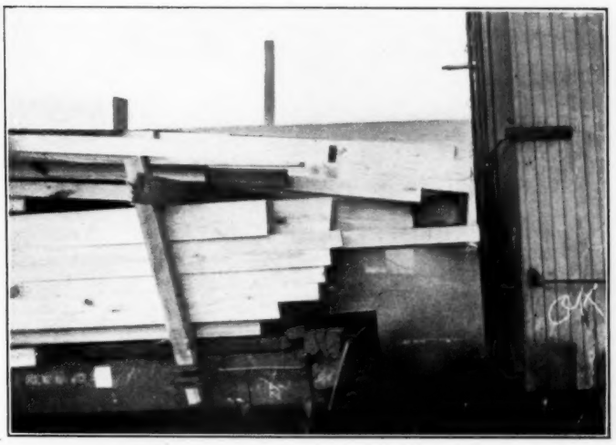
provide that lumber loaded in open top cars must not extend beyond the end sill of the car unless protected by an idler, nor within 6 in. of the brake wheel. If the load extends above the side of the car, stakes must be provided to hold the lading at the side. The number and size of the stakes depend on the height of the car side, the height of the load, the number of piles making up the load and the method of loading. The tops of opposite stakes must be fastened together with boards or with wire. Lumber of equal thickness must either be lapped or have strips placed transversely between the lading and not more than 30 in. apart vertically. If the shipper so desires strips may be placed crosswise between each layer of dressed lumber. These rules have been in effect for many years. The revisions which have been made from time to time have been of a minor character.

It will be noted that the rules governing the loading of lumber in open cars are based on the assumption that friction will be sufficient to prevent lateral shifting of the load. The adoption of heavier motive power and the increase in the length of trains in recent years has increased the severity



Damaged Equipment Contributes to the High Cost of Transporting Lumber

of shocks in starting, stopping and switching. The result has been that the transportation of lumber loaded in open cars has in recent years been a source of considerable trouble and expense to the carriers. The shocks encountered in ordinary service often cause lumber to shift. If any portion of the load slides beyond the end of the car or comes within 6 in. of the brake wheel the car must be taken out of the train and the lading reshaped to conform with the loading

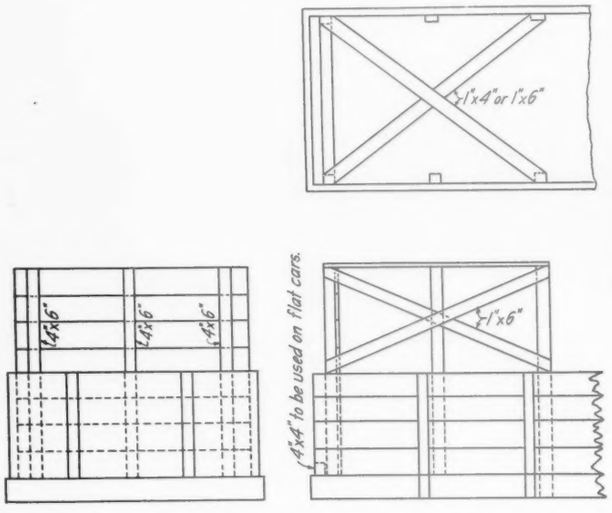


A Load That Will Probably Check Short at Its Destination

rules before it proceeds to its destination. The tonnage of lumber shipped in open top cars is large and the loss involved in this switching and reshaping of loads is a considerable item. Some idea of the trouble experienced in hauling lumber in open top cars can be gained by examining the illustrations which accompany this article. All the photo-

graphs of shifted loads which are shown were taken at one yard in a single week.

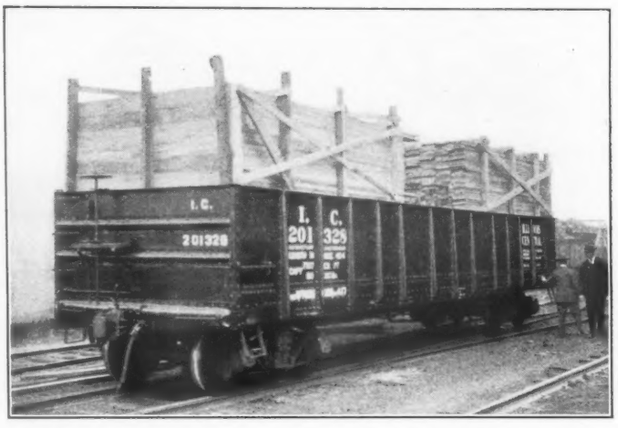
The Illinois Central a short time ago conducted a special investigation in order to determine the loss of service from cars due to the reshaping of loads which had shifted in transit. During a period of three months this road handled 7,926 cars loaded with dressed lumber. The total car days' delay on these shipments amounted to 17,778, an average of 2.24 days per car. Had it been possible for the Illinois Central to avoid the delays to cars loaded with dressed lumber during the three months referred to above, the road would have had 194 more cars available for service. It is estimated



Type of Bulkhead Used on the Illinois Central

that it would have secured increased revenues amounting to about $85,000. In addition to this there would have been a considerable saving due to the elimination of the expense of switching cars and adjusting loads, and claims for damage to lading. The cost of switching was probably about 50 cents a car and the cost of reshaping the load considerably greater. In the month of May alone the cost of transferring and reshaping loads of lumber at Memphis amounted to $39,308. Probably one half of this expense was chargeable to loads on open cars.

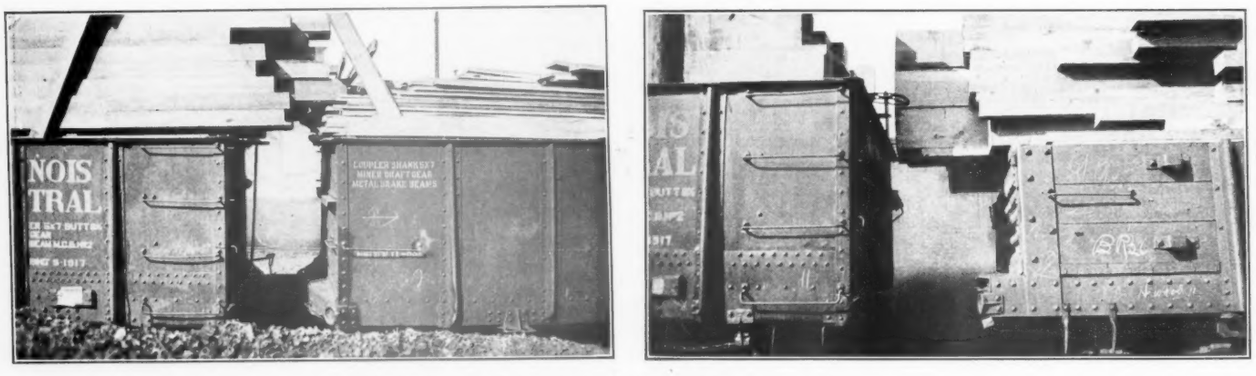
While accurate data concerning the amount of dressed lumber shipped in open cars on the railroads of this country are not available, an estimate of the saving of cars that would be effected if the practice of bulkheading was generally adopted will show the importance of the subject. The total lumber traffic of the country in the year 1917 was probably about 160,000,000 tons. Of this amount about 65 per cent or 104,000,000 tons consisted of lumber wholly or partly dressed, which causes trouble by shifting. Open cars are used to handle probably 25 per cent of the dressed lumber shipped, or 26,000,000 tons. Assuming an average load of 50 tons per car this amounts to 520,000 carloads. As each shipment would require under normal conditions about 18



Bulkheads on Lumber Cars Keep the Load Where It Belongs

days from origin to destination, the average number of open cars used in the lumber traffic is 25,600. If an average saving of two days per trip could be secured by bulkheading the cars the number required to handle the traffic could be reduced to 22,800, thus effecting a saving of 2,800 cars. In addition to the saving in equipment there would be further economies due to the reduction of charges for switching and reshaping of loads and also to the elimination of claims for damage to lading.

While the Illinois Central was investigating the delays due to the shifting of loads, a special messenger accompanied one shipment of 50 cars of lumber from a single company. Of these 50 cars 22 were delayed three or four days on account of the necessity of reshaping the load. The railroad had experimented with bulkheads placed in the ends of the cars to keep the lumber in place and had found the results



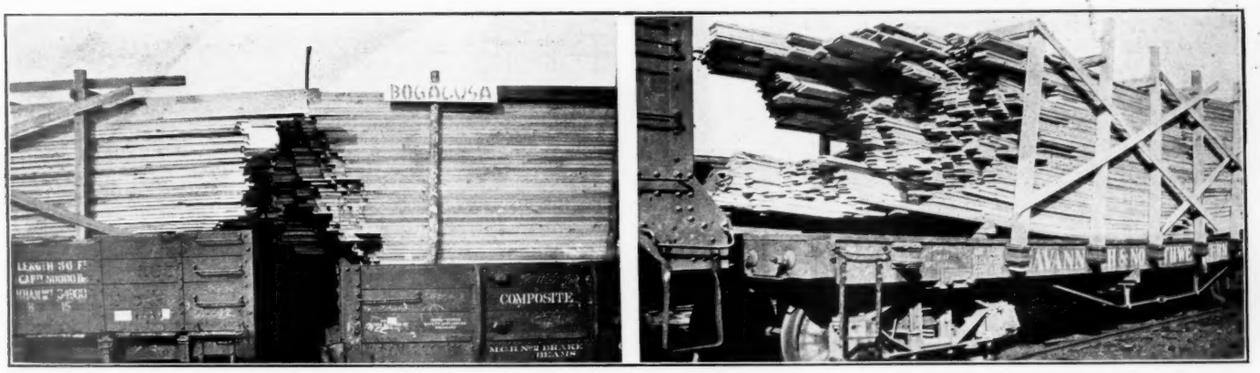
Shifting Is Not Confined to the Smaller Sizes of Lumber

of this practice very satisfactory. It was so evident in this case that the delay was due to improper loading that the company from which the shipment in question was received was persuaded to bulkhead their cars. They have continued to follow this practice and delivery of shipments from this company are now made without the delay formerly experienced. Trains of 50 cars have been brought to their destination without a car removed or sidetracked for reshaping.

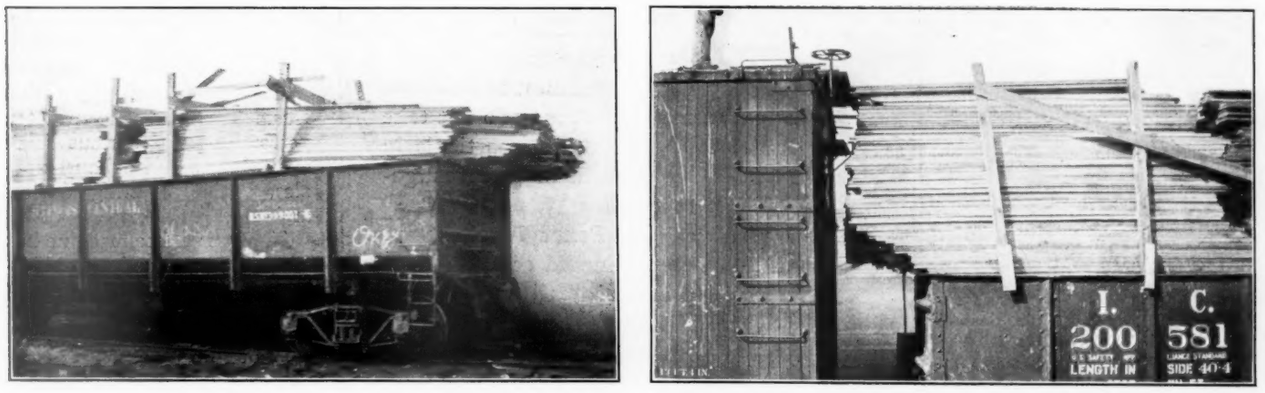
The method of bulkheading which has been in use on the Illinois Central for loads on gondolas or flat cars is shown in the illustration. The end is made up of three upright posts, 4 in. by 6 in., to which are fastened 2 in. by 12 in. boards. The corner post is fastened to the third side post by diagonal strips of 1 in. by 6 in. lumber and similar bracing connects the tops of the posts. In case the bulkhead is used on flat cars, a 4 in. by 4 in. timber is placed crosswise at the end of the car to hold the lower ends of the posts in place.

That shippers are willing to co-operate with the railroads in this matter of bulkheading cars is shown by the fact that one large producer of lumber has adopted the practice while the Southern Pine Association has urged its members to consider the advisability of bulkheading their shipments. The main obstacle to the adoption of the practice is the fact that the shippers object to using so much lumber to secure the load unless the roads make a corresponding increase in the dunnage allowance. The present rules of the three principal freight classifications provide that an allowance not to exceed 500 lb. will be made for temporary stakes, dunnage or supports when required to protect and make secure for shipment property on flat or gondola cars upon which carload rates are applied. It has been urged by the shippers that the practice of bulkheading be made mandatory and the dunnage allowance increased to 1,000 or 1,500 lb. The carriers claim that the lumber used in bulkheading has some commercial value and that the shippers should be able to sell it to the consignee. The shippers on the other hand contend that the lumber used for securing loads has no market value and if additional dunnage is required the allowance provided in the tariffs should be increased.

Both the shippers and the railroads would benefit by bulkheading open cars loaded with lumber.



Typical Examples of Shifted Loads



Loads of Lumber Going Out "Over the Top"

I. C. C. SAFETY INSPECTOR'S REPORT

During the calendar year ended December 31, 1916, 136 employees were killed and 2,440 injured in coupling and uncoupling cars; casualties resulting from employees coming in contact with overhead and side obstructions and from falling from and getting on and off cars occasioned 564 deaths and 15,937 injuries. This represents an increase of 13 in the number killed and 246 in the number injured in the former class of accidents, and 59 in the number of killed and 2,126 in the number injured in the latter class of accidents, as compared with the fiscal year ended June 30, 1916.

During that fiscal year, 187 cases, involving an aggregate of 542 violations of the law, were transmitted to the several United States district attorneys for prosecution. Cases comprising 127 counts were tried, of which 88 counts were decided in favor of and 37 counts adversely to the government; 2 counts are still pending decision. Cases involving 478 counts were confessed, and 10 counts were dismissed.

During the past fiscal year there were transmitted to the several United States district attorneys for prosecution 113 cases, involving 1,197 counts, of violations of the hours of service act. Cases involving 811 counts were confessed and 444 counts were tried, of which 125 were decided in favor of the government and 198 in favor of the carriers. The remaining 121 counts are still pending decision. Cases involving 878 counts were dismissed, 841 of which were based upon the carriers' failure to report all instances of excess service, as required by an order of the commission. Two cases were decided by the Supreme Court, one against and one in favor of the government. In the circuit courts of appeal 8 cases were decided in favor of the government, and 3 cases were decided in favor of the carriers. Other cases are still pending.

Engineering Building, Pennsylvania State College.

MAINTAIN INDUSTRIAL FELLOWSHIPS!

BY C. H. BENJAMIN
Dean of the School of Engineering, Purdue University, Lafayette, Ind.

RAILWAY problems are peculiarly attractive to the scientific investigator because they are so definite and so well developed. The railroad man usually knows just what he wants and why he wants it. Furthermore, the investigator knows that immediate practical use will be made of the data which he accumulates or the principles which he proves.

Purdue University was one of the first technical schools to take up railway work, and it has consistently carried out the policies thus inaugurated. The principal credit for the development of railway testing and investigation may safely be given to W. F. M. Goss, and it was through his efforts that Purdue University came to be recognized as the leading authority on railroad mechanical problems.

Beginning with the installation of the Purdue locomotive Schenectady in a separate building in 1895, the organization of a railway laboratory was continued from year to year. In 1898 the Master Car Builders' Association provided a brake shoe machine and an air brake rack, thus inaugurating the official laboratory of the association. Subsequently, a drop press and other apparatus were added. In 1909-1910 the air brake rack was entirely rebuilt and located in a building provided for the purpose. In 1912-1913 a machine for testing eccentric or flat wheels was installed, with the assistance and co-operation of the New York Central.

The various pieces of railway apparatus have served not only for purposes of investigation, but as efficient aids in the education of students.

THE UNIVERSITIES can do much for the railroads in the way of making special investigations and tests, but the latter must do their part in providing the funds. Dean Benjamin, of Purdue, suggests that one way of doing this would be to maintain industrial fellowships.

Professor Schmidt, of Illinois, suggests that the railroads contribute to keep the locomotive laboratory in continuous operation. It seems a shame that the roads do not take advantage of this opportunity, particularly since so many profitable fields of investigation are still unexplored.

Professor Wood, of Pennsylvania State College, makes some splendid concrete suggestions for a practical "railroad-college" course. Surely it is time that the leading railway mechanical associations made some progress in solving the big task of really training men for the important work of the mechanical department.

WORK ACCOMPLISHED AT PURDUE

But a brief synopsis can be given to indicate the work accomplished in the railway laboratories. The locomotive Schenectady, becoming successively Schenectady No. 2 and No. 3, as its design was modified to keep up with the times, served first as a medium for Dean Goss' experiments on high steam pressure and on superheat. These experiments form the basis of his various publications on "Locomotive Performance," "High Steam Pressures in Locomotive Service" and "Superheated Steam in Locomotive Service."

The work on superheated steam was continued by Professor Endsley, and formed the subject of a paper presented to the American Railway Master Mechanics' Association by the writer at the 1912 meeting.

Other experiments on this locomotive have concerned the performance of various front ends, stacks and exhaust nozzles, spark arresting devices and superheaters.

The brake shoe machine has served its purpose in establishing the loss of friction and wear for different types of shoe. The work done on this machine has furnished the basis for the standards now in use by the M. C. B. Association. A résumé of these tests is given in the proceedings of the Association for 1915, Vol. 49, p. 59.

In a similar manner, the work done on the air brake rack and the drop press has furnished data for the standard specifications now in use by the railways.

The laboratory for testing materials has had an important part in railroad work. Among the more recent investigations carried on in this laboratory are detailed studies of side frames and of brake beams where, by the use of a strain

gage, local deformations and stresses were analyzed and accounted for.

CO-OPERATION—A PRESSING NEED

As long as new standards are adopted and new designs originated by the railroads, the co-operation of the university will be demanded. He would be a rash man who would predict that improvement in railway design should in the next twenty-five years be any less marked than in the twenty-five just passed.

One way in which the railroad may co-operate with the university to their mutual advantage is *by maintaining an industrial fellowship, the incumbent of which shall devote the whole or a part of his time to investigating railroad problems. Such assistance is a pressing need at the present writing.*

RAILROADS SHOULD MAKE USE OF LOCOMOTIVE LABORATORY

BY EDWARD C. SCHMIDT
Professor of Railway Engineering, University of Illinois, Urbana, Ill.

The University of Illinois has for years co-operated with the railways in research, and it conceives such co-operation to be one of its duties. It has frequently received assistance from the railroads in prosecuting its own problems, and it has, on the other hand, given assistance to many roads in problems initiated by them. In co-operation with the railways it has carried on, during the last fifteen years, *a good deal of research in such fields as train resistance, tonnage rating, car truck design, coupler design, the design and performance of water columns, stresses in car wheels, stresses in railway track, the performance of different kinds of coals, brake shoe performance, etc.*

Whenever the investigation proposed seems likely to produce results of scientific quality and of general interest the university stands ready to contribute the use of its equipment and the services of its staff. In special cases it has contributed also a portion of the funds needed for such investigations; although it has never seemed to us that we should be expected to go that far.

Our locomotive laboratory is as well equipped as any in this country to test modern locomotives. While we have been able thus far to carry on enough laboratory work to serve our own purposes and to justify the installation of the plant, it has not been in constant operation, nor have we ourselves the funds to keep it constantly at work. *We should be glad to enter into co-operation with any railroad or with any group of railroads looking toward the fuller use of the laboratory, either in the study of a particular problem or in varied investigations extending over a term of years.* We have already made to certain roads proposals to this end and we stand ready to renew them at any time. Four or five thousand dollars contributed by each of a half dozen roads would suffice to keep the plant in continuous operation for a year. We should be willing to contribute to such a purpose the use of the plant and the services of members of our staff without charge. Whether we should be willing or able to offer any larger measure of co-operation would have to be determined in the particular instance; but even this contribution on our part offers to the railroads what has always seemed to me an exceptional opportunity for the solution of the numerous problems which present themselves to railway officials.

ADVANTAGES OF LABORATORY TESTS

The advantages of laboratory tests over road tests probably need no further defense. Most of us who have had experience in both are willing, I think, to concede that even where the problems can be worked out with equal accuracy in the laboratory or on the road, the laboratory procedure is likely to be very much less expensive; and there remain, of course, many problems in locomotive performance and design which cannot be attacked by road tests with any prospect of success. Neither will any one deny the great need for further research in railway problems. There are numerous questions to be solved and new ones continually present themselves. The demand for their solution is all the more urgent at such a time of emergency as the present; and the prevailing tendency to make the emergency an excuse for deferring all such work seems to me short-sighted and unwise.

One of the chief functions of the Engineering Experiment Station of the University of Illinois is to do whatever it can to promote such co-operation between the universities and the industries as is under discussion, and we may be relied upon here always to do our share in any such enterprise.

CO-OPERATIVE "RAILROAD-COLLEGE" COURSE

BY PROF. ARTHUR J. WOOD
The Pennsylvania State College, State College, Pa.

Who is to train the future railroad mechanical engineers? The question cannot be evaded. It means much more to-day than it did even a year ago, and no railroad official can fairly answer, "That is not *our* job. The engineering schools must speed up." My aim is to point to a better way than suggested by this reply, and to indicate how co-operation may become effective. Col. H. G. Prout, when general manager of the Union Switch and Signal Co., once remarked, "The spirit and the temperament which make co-operation not only possible, but natural, are essential to any success in any great enterprise. I am not speaking of perfunctory or official co-operation, but of the spirit which makes folks work together to a common end, by instinct and inclination."

The railroads do not have in training a sufficient number of men of the right stuff. Here is a typical example: Of last year's graduates of the Pennsylvania State College, two-thirds of those in railway mechanical engineering are now in France with Company E, 19th Engineers, and not one of those in mechanical engineering is in railroad work.

RAILROADS AND COLLEGES SHORT-SIGHTED

Most of the mechanical engineering graduates who enter railroad engineering departments and rise to places of influence have become attracted to the work before leaving college. Aside from possible home influences, they are not usually drawn in that direction, partly because mechanical engineering is many sided and in most colleges the student receives instruction in the various mechanical lines—*except in railroad engineering.* Again, not more than about one out of ten teachers of mechanical engineering is familiar with the transportation problem, and naturally this line of service has not been given its due weight. On the other hand, the railroads as a whole expect a certain product, but have not studied the question thoroughly, and have placed a load on the colleges which they themselves should share in carrying. This condition has been apparent for years, and both the railroads and colleges have been short-sighted.

The point at issue should be kept clear. I am not urging specialization. The college, first and last, must teach fundamentals, and teach these thoroughly; but every college is a profit-sharing enterprise and must balance its account with those who supply the funds. In all this work, the college is the specialist aiming to render efficient service. The student is being fitted to be of real value in the world, and he should have a touch of active engineering work to help in a wise choice of vocation. It is the business of the college to help him to find himself.

GOOD EXAMPLE OF CO-OPERATION

The Pennsylvania State College is located fifty miles from one of the best engineering laboratories in the country.

I refer to the Altoona shops of the Pennsylvania Railroad. Co-operation has been made effective along the following lines: Six years ago the college organized an apprentice school at the Altoona shops, which has since been doing good work under a joint agreement; engineering problems have been worked over together; lectures have been given by engineers of the company; investigation work has been carried on at the college at the instance of the railroad; frequent inspection trips to the shops have added interest, and the company has donated a dynamometer car, a locomotive and other equipment.

Of more direct value in the training of college men is the work at the locomotive testing plant. To better appreciate this aid, reference may be made to one of our recent trips to Altoona. Twenty-six senior mechanical students spent two days at the shops. The party was divided into two sections or groups, one of these went through the shops and laboratories under the guidance of an engineer especially qualified to make the inspection of value, while the other group was at the testing plant. This group was shown the layout, method of conducting the tests and the main-line purpose of the testing plant. Each student then put on his overalls and, being assigned to take certain readings, filled out the log sheets, being guided by the trained employees of the company. The data, with a sample of coal, were taken back to the college, the results worked up independently and a careful report was made of the test. This study presents to the student the locomotive as a power plant, gives a tie-up to theory and practice and makes for a better prepared graduate. J. T. Wallis, general superintendent of motive power, and the engineers of his staff have generously co-operated, and many colleges have been benefited by studying the methods used jointly by the Pennsylvania Railroad and the Pennsylvania State College.

For years the students have made test runs with the college dynamometer car and locomotive over the lines of the Bellefonte Central Railroad. Recently, the Westinghouse Air Brake Company presented to the college a compound air compressor with testing equipment, and in return the Engineering Experiment Station submitted a careful report of special tests on the compressor.

CONCRETE SUGGESTIONS

While each case calls for its own solution, the writer urges careful consideration of the following suggestions:

(1) Special courses should be given to a limited number of men in the engineering departments of the railroads who have not had a college education. Two leading qualifications should enter into the selection, (a) fitness, and (b) probable permanence as an employee of the company.

(2) As an emergency measure, cut down the special apprenticeship time to a minimum, making the training more intensive.

(3) Let each railroad have one of its men make frequent trips to a university, become acquainted with the faculty and the courses and encourage undergraduates to work during vacations in the shops and laboratories. Having tested out a young man, make him feel that there is a place in the organization which can be won by hard work.

(4) Railroads should be on the lookout for bright fellows in regular apprenticeship courses and encourage such to take a college course, keeping in close touch with their work while away from the shop.

(5) The college should look into more of the live problems of the railroad mechanical engineer.

(6) The American Railway Master Mechanics' Association should have an active committee working on the question. Each railroad and at least one college in every state should lay out a clean-cut policy and should co-operate with such a committee. Let this committee propose a general policy for a co-operative "railroad-college" course.

PRACTICAL RESULTS FROM MODERN APPRENTICESHIP

BY H. S. RAUCH*
General Foreman, New York Central, Avis, Pa.

At this time, when the need for trained mechanics is so great and the supply so limited, modern apprenticeship methods can play a large part in overcoming the difficulty.

With the aid of properly applied apprenticeship methods, modeled on the lines of the New York Central or Santa Fe and supervised by competent instructors in class room and shop, young men can be made proficient from an output standpoint in a very brief period of time and in addition accumulate a mechanical education that will be invaluable to themselves and their employers.

Take a specific case: a young man 17 years of age, physically strong and mentally equipped with a good common school education, is placed in a shop under the tutelage of a competent instructor; one who is in sympathy with him and qualified to bring out the best there is in him. He is put to work on a lathe on which the more simple classes of work are done and in ten days or two weeks will produce the capacity of the machine. Leave him there three months and then move him to a more important lathe, giving him careful attention, and he will soon be producing to the capacity of this new machine, and so on, through his four years' course. In all this, the apprentice school is playing an important part, as he learns from the first to make sketches, read blue prints, and to supplement his mathematical education and apply it to mechanics. His education in the class room is dovetailing into the shop education and producing efficiency in months which would take years under the old method of letting him shift for himself, with an occasional call down from the "boss" because he did or did not do something he should or should not have done.

It is a duty which the railroads owe to posterity, properly to train young men to fill the places of the older ones, who will not always stay at their posts.

Railroads have outgrown themselves, have outgrown the number of available workmen, and the only way to anywhere near meet the situation is to train the boys who are under the military age. Give them an intensive training such as our government is doing with the men in the National Army.

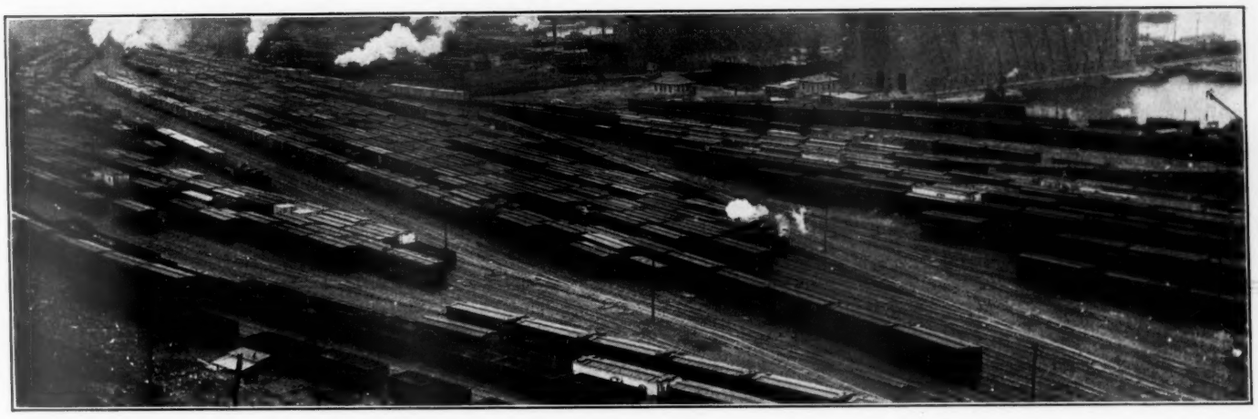
Let it not be understood that the writer desires to convey the idea that a shop can be run wholly by apprentices, but rather that the gap can be filled to a very large extent by a modern and intensive apprenticeship system.

A word about the apprentice instructors: These men must be carefully selected and must be men who are in sympathy with the boys; men who understand human nature in the making, and who are capable of getting the best efforts from the boys; men of high integrity and honesty who can be looked up to by these embryo mechanics and who in that way will raise the boys to their level.

It should also be understood that all does not rest with the instructors. Shop officials must interest themselves in the welfare of the boys, giving them a word of encouragement occasionally, and dropping into the class room and becoming acquainted with the boys and the character of their work as much as their time will permit.

When the apprentice graduates are assigned to work as mechanics, the chief officer of the plant should have a short talk with them, endeavoring to draw them out as to their desires and aspirations. This will aid in placing them to better advantage and at the same time will make them feel that their existence is known to those in charge and that their efforts will be watched.

* Mr. Rauch was formerly an apprentice instructor, and has a close interest in and sympathy for the apprentice.



More Service From the Equipment

Railroads and the Different Departments Must Co-operate for Maximum Service from the Facilities

BRIEF SUGGESTIONS from various men in charge of mechanical departments of railroads in both the East and the West for improving the general equipment situation are given below. Some of these are quite original and all of them are pertinent to the prevailing conditions. They are constructive and show that the mechanical departments of our railways are alert and seeking to successfully meet the extreme demands for power and equipment.

> THE important problem confronting the mechanical department is keeping the equipment in condition for active service. This can only be accomplished by hard and conscientious work. No short-cut or temporary practices can successfully be followed. The equipment must be maintained, improved and loaded to capacity. Repair work must be done right and made to last. As Mr. Manning says: "What the future will bring forth is too indefinite to defer maintenance and risk semi- or complete breakdowns."
>
> Every minute a car or locomotive is out of service for repairs should be made to count. All departments must co-operate with each other. Every railroad must be willing to assist its neighbor. Every employee must keep his country's need constantly before him. Organization, co-operation, industry and intelligent use of one's resources are necessary for success.

CO-ORDINATE REPAIR FACILITIES AND MATERIALS

BY J. H. MANNING
Superintendent Motive Power,
Delaware & Hudson

I know of no better way of increasing the activity of the power than by fully maintaining it; what the future will bring forth is too indefinite to defer maintenance, and risk semi- or complete breakdowns which would affect so widely the entire transportation problem. It has been demonstrated that power can be properly maintained with no more than eight per cent, or better, of a total locomotive equipment out of service. This should be done even if it is necessary to increase the activity of the shop by establishing a night force with skilled help and by promoting competent helpers or handy men in case regular mechanics cannot be obtained.

There should be closer co-operation between the different railroads in regard to the general repair of locomotives with a view of having those roads which can repair locomotives for such roads whose shops and facilities are taxed beyond their capacity. There is no question but that parts of the country will have more and better labor than other parts. It would not be feasible to transfer the workmen, but it would seem entirely practical to move the power requiring attention to the point where assistance can be given.

A committee could be appointed by the railroads to canvass the entire power situation of the country with a view of determining, first, what locomotives are awaiting repairs and the possibility of their being taken care of by the owners, and second, the reason for their being held for repairs, such as for want of material and the kind of material lacking; for the want of help and the character of the help, and for want of proper shop facilities and the character of these facilities. It is entirely possible that other railroads might have a surplus of material or that they could spare some of the particular material which a certain road lacks and in this case a transfer could be made. If it is due to insufficient or defective labor, probably s o m e t h ing could be done in this direction. If it was due to inadequate facilities it is entirely possible that another railroad might have sufficient capacity to take care of those roads in difficulty. This committee could further assist the railroads by anticipating the requirements of the badly pressed roads along the above lines and thereby reduce the time it is necessary to hold the locomotives out of service.

By putting such information in the hands of this committee it would bring under one head the needs of the railways in the mechanical department and would give it concrete information which it could lay before the proper representatives of the government in Washington and urge upon them the necessity of promptly delivering material to suc-

cessfully meet these conditions. The same co-operation could also apply to cars.

ENCOURAGE THE EMPLOYEES

BY GEORGE DURHAM
Superintendent of Motive Power and Cars, Wheeling & Lake Erie

There is a very great deal that might very properly be said on the subject of what can be done to increase the efficiency of the mechanical department at this particular time, but without attempting to say all there is to it, I suggest that one of the most important things in connection with the whole situation is the necessity for courage and cheerfulness on the part of supervising officers which *must* be transmitted to the forces by *personal* contact.

The superintendent of motive power, master car builder, master mechanic, road foreman of engines, roundhouse foremen and gang foremen will all have to get closer to the job that they may *know* (not guess) what is required, and encourage the forces under their direction by personal example and precept (not by abuse) in the important matters that are before us, and *must* be taken care of.

EXTEND LOCOMOTIVE RUNNING REPAIRS AND ADOPT A DEFINITE CAR SHOPPING PROGRAM

BY A MECHANICAL SUPERINTENDENT

Of course, the way to get the greatest possible use out of equipment insofar as the mechanical department is responsible, is to have the largest amount of equipment possible ready for service. In other words, to have out of service only such equipment as is absolutely necessary for a reasonable shopping margin.

With regard to locomotives, it is my opinion the thing to do is to have a program of assigned mileage for all classes of locomotives, which mileage they must make before they pass through the back shop for general repairs. When general repairs are given to locomotives the work should be of such a thorough character that maximum mileage can be obtained before they are again returned to the back shop. We have made quite a study of this matter and have accomplished considerable along these lines. It is particularly important to exercise great care and judgment in repairs to the boilers. Tight boilers mean that the locomotives can run longer before they are obliged to return to the shop for general repairs. Roundhouse forces can be encouraged to repair the machinery and run it along for a great length of time, but when the boiler begins to weaken, it is a very difficult matter to do much to the locomotive, except send it to the back shop for general repairs. We have been very careful with our boiler repairs in the back shops. We are welding the flues of all locomotives to the back flue sheet electrically. We also have our back shops piped with gas, as we find that each method of welding has its own field. We are satisfied that making proper boiler repairs has been a big help to us and it has enabled us to increase the mileage between shoppings. We are averaging a little less than 7 per cent of our locomotives in the back shops.

We have a definite program for back shop repairs to freight cars. By so doing we not only reduce the maintenance cost of freight cars, but reduce the number of bad orders. At the time that back shop repairs are made to freight cars, all necessary repairs should be made. If the design is inadequate to meet present conditions, the weak parts should be reinforced. If it is not practical to do this, the car should be destroyed and written out of service. Another very decided advantage of this method of handling freight car repairs is that you can notify the supply department and purchasing department a year in advance, if necessary, what the repair program is going to be, and thereby enable them to line up the necessary material for carrying out such a program. Of course, the material situation is a serious one in this country now, and in many instances it controls the kind and the extent of repairs to be made. Fortunately we have been able to overcome this trouble by outlining our program far in advance. As an illustration; for our 1918 freight car repair program we now have practically all the manufactured material lined up. With such a program for the last year we have averaged each week about 3 per cent of our freight cars in bad order.

SYSTEMATIZE REPAIR WORK

BY F. J. HARRISON
Superintendent of Motive Power, Buffalo, Rochester & Pittsburgh

At the present time the Buffalo, Rochester & Pittsburgh is doing an enormous amount of business and everybody connected with the railroad is extremely busy. We have found that by scheduling engines through our shops that the output of the shops has been materially increased. We are also following the practice of holding out of service at engine terminals only those locomotives which can be given prompt attention and returned to service with a minimum delay. The workmen in the engine houses are organized under gang leaders which has been found particularly helpful. The supervision of repairs to the locomotives has been tightened up, which insures better work being performed. The locomotives in all services are assigned to regular crews which we believe will be of great assistance. The mechanical department officers have frequent staff meetings at which important problems are discussed.

CO-OPERATE TO REDUCE ENGINE FAILURES

BY F. W. TAYLOR
Superintendent of Motive Power, Missouri, Kansas and Texas

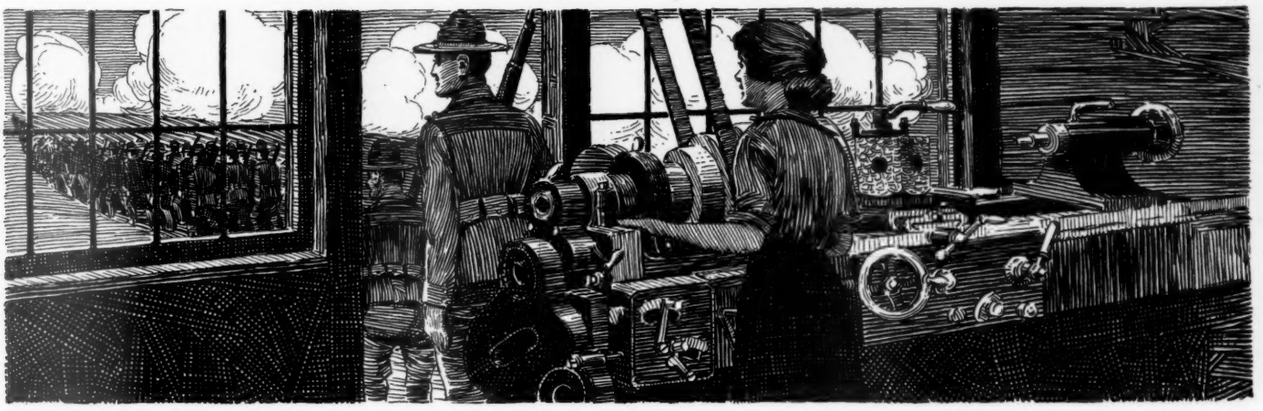
To get the greatest possible use out of the equipment in charge of mechanical officers is the problem that is uppermost in their minds and receiving their best thought and action. Particular attention must be given to putting the locomotives through the shops promptly and making the repairs thoroughly. After a locomotive has been turned over to the transportation department everybody should co-operate to increase the service life of the locomotive and make it produce the greatest possible mileage. Every effort should be made to reduce and eliminate the engine failures. The locomotive should be passed through the engine terminals in the shortest possible time. It is important that a good grade of coal be provided, as with poor coal the proper service cannot be obtained from the locomotives and engine failures will occur. The water supply is another very important thing. Bad water materially shortens the life of the boiler, which is the backbone of the locomotive. The kind of water used should be given careful consideration and the best methods of treating it determined.

DON'T PUT ENGINES OUT UNTIL THEY'RE RIGHT

BY GENERAL MECHANICAL SUPERINTENDENT

The mechanical department, to get the greatest possible use out of the equipment in its charge, must always aim to keep the power in condition to give maximum efficiency, and to keep the bad order cars down to a reasonable figure. Do not send locomotives out unless work has been done which will allow them to go over a division without delay or failure. In times of stress it is a common error to neglect the work, but it is far better to hold a locomotive for needed repairs than to send it out in a condition which will almost insure a failure. It has been our practice for years to do the work required, and the answer has been found in the prompt movement of trains.

Hysterical calls for locomotives that have not yet arrived do not move freight. Have the work done in so far as possible, if maximum tonnage is to be moved.



WOMEN FILL MEN'S PLACES IN SHOPS

Roads Employing Women Find Results Satisfactory. Suggestions for Their Employment and Training

THE MEN in the mechanical departments need a spirit of patriotic service to carry on their work during the present crisis. The foremen must impress on the men that they are "in the trenches," that they are doing as much for their country as if they were wearing uniforms at the battle front rather than overalls in, perhaps, the dingy shop.

In spite of the large numbers of men in this country who are skilled in the shop trades there is already a serious shortage of mechanics. When more are taken away, energetic measures will be required to cope with the situation. The government will demand large forces of skilled mechanics as the number of men in the army increases. The technical branches of the army comprise about half the entire armed forces. It will be necessary for the United States to manufacture enormous quantities of munitions which will also require the services of many skilled mechanics.

This country has as yet adopted no definite method of handling the labor problems caused by the war, and some industries, by offering higher wages than the railroads can pay, have drawn large numbers of men from the shops. In many cases it is very difficult to fill the places thus made vacant. With the marked shortage of labor one of the principal incentives for maximum production has been lost. Men have formed the habit of "laying off" more frequently and some shops report that it now takes three men to do the work that two formerly did.

Instilling a spirit of patriotic service in the men will help the situation but this will not fully overcome the difficulty. The railroads will undoubtedly find it necessary to put into practice the "dilution of labor," which has produced such wonderful results in Great Britain. In the British shops, women or unskilled men are brought into the plant to do unskilled work, and the workers whose places they take are put on some of the simplest jobs. The men who have been performing simple operations are put on work requiring more skill. This grading up process is continued throughout the ranks and thus the shortage of skilled help is overcome. Another method adopted has been to confine the best mechanics to those operations where their skill was necessary. These measures have made it possible to use women on a great variety of work. There is one shell shop in England which has but one skilled mechanic for every fifty women and in point of output it ranks among the first in the country.

"IN NINETEEN FIFTEEN all our employers regarded the introduction of a woman into a machine shop as one of the horrors of war, about on a par with Zeppelin bombing and the shortage of sugar," said one of the officers of the labor supply department of the British Ministry of Munitions, speaking of the part women have taken in the industries of Great Britain. "But," he added, "the woman has been found to be a better and more conscientious worker than the unskilled man."

The labor problems of the railroads are daily becoming more serious. Increased output is demanded, yet the supply of men is constantly decreasing. Everything indicates that this country, like Great Britain, will find it necessary to employ women in large numbers. The experience of the roads that have employed women labor has been very satisfactory. Those who have not yet adopted this measure should consider it.

SELECTION AND TRAINING OF WOMEN WORKERS

BY D. C. BUELL

The experience of England, France and Germany under the most trying war conditions has demonstrated the fact that women can be used to replace men in practically every branch of industrial activity. The question is not *can* they be used, but how, when and where *should* they be used?

There is nothing particularly difficult in either the selection or the training of women to take the places made vacant by men in many branches of railroad work. In fact, the apparent ease with which women can be substituted

for men is apt to be misleading. The real problem in connection with the employment and use of women in railroad service is two-fold. First, the analysis of practical conditions to make sure that women can be properly and efficiently substituted for men; and, second, the supervision of women as they are employed to make sure that they are properly instructed in their duties and are let alone so that they will have an opportunity to "make good."

In foreign countries where large numbers of women have been employed, there has never been any question as to women being able to do things—even unusual things. The failures have been due to the use of poor judgment in selecting work for them, and in the failure to place them in surroundings where their health would be conserved. The most serious phase of the problem has been in allowing women to work in surroundings or under conditions where it was hard to maintain standards of morality. In fact, reports indicate that in many sections of Germany, and in some sections of other countries, where women have been thrown indiscriminately with men, the standard of morality has fallen to such an extent that conditions are almost indescribable.

No country has higher ideals of womanhood than America. These ideals must be maintained in spite of the tragedy of war, and they can be maintained even though large numbers of women are employed in varied industries, if those responsible for their employment give the subject the careful study and attention which it requires.

Where conditions indicate the necessity of employing any considerable number of women in railroad service, the preliminary step, before the plan is undertaken, should be the making of a careful survey of the entire situation to find out in what places and in what numbers women can be economically and practically substituted for men. This survey may include only one department, but to be most effective should include every department of the railroad. In making such a survey, due consideration should be given to the hours-of-service laws regulating the employment of women in the various states; to the customary working hours in different offices and departments; to the question of whether additional facilities, such as toilet rooms, dressing rooms, rest rooms, separate lunch rooms, etc., would be required, and the expense involved; and to the conditions under which the women would have to work and still be properly supervised and safeguarded, to make sure that the sexes would not be brought into undesirable association. The question of fatigue should also be considered; in other words, consideration should be given to the amount of nervous strain under which the work would have to be done, to the question whether the work would require the employees to stand all day or not, to the amount of physical exertion required to do the work, etc. Such a survey would disclose many positions where women could be readily used, and many other positions where they could be used if conditions became acute, with a readjustment of working hours or working conditions.

The employment of women in any considerable numbers immediately brings up the problem of the training of women to fill efficiently positions to which they may be assigned. In a large number of cases, women can be put to work immediately without any special preliminary training, by having skilled workmen assigned to show them what they are to do and to instruct them in the way to do it. In Great Britain probably twenty times as many women have been trained in the plants as in the schools. Only by the co-operation of the skilled men who have willingly trained women in the shops has the British Government been able to obtain the present enormous output of munitions.

On the other hand, it is, no doubt, desirable in many cases to give preliminary training to prospective women employees when it is practicable to do so. Shop surroundings are entirely strange to the great majority of women. Not only must they become accustomed to the noise and confusion of the shop; but, in addition, they must learn the intricacies of the particular machines or work to which they are assigned. If they could be given a brief preliminary training, to accustom them to at least a part of the new work ahead of them, it would undoubtedly enable them to fit into their new work more readily, and be a considerable factor in reducing the number of minor injuries to which women are now subject in starting work in shops.

One plan for giving preliminary training to women who are to be employed in railway shop work, which would seem entirely practical, would be to arrange with public school and university authorities at various points where these institutions have manual training departments or shop facilities, so that night classes could be formed, under the direction of competent instructors or foremen, to familiarize women with the fundamental principles of machine-tool operation. In such night classes, machines, machine operation, and machine shop methods could be explained. The women could be given actual experience in setting up work in machines and in some of the more common machine operations. They could be taught the different classes of tools used and the proper methods of setting tools for different classes of work. The uniform that was to be adopted in the shop could be furnished, and the women accustomed to wearing this uniform before actually entering the shop. Two or three weeks of such preliminary training, under proper direction, would be sufficient to take away much of that strangeness which a woman who enters the shop for the first time to go to work now feels. In view of the hearty co-operation which would be given to a plan of this kind by schools and universities, it would seem that it was worth more than passing consideration.

If it were not possible to arrange for training school facilities outside of the railroad shop, there is no reason why a night training class could not be formed right at the shop, and a similar course of instruction given four or five evenings a week during a period of several weeks, to acquaint prospective employees with the work before them.

Such a scheme of night training would permit many women who were employed during the day, to take advantage of the preliminary training during the evening, without loss of time or money. Such a training class would permit the foreman or instructor in charge to weed out undesirable or inept applicants, and the plan could be flexible enough so that just as soon as the instructor considered a student competent, arrangements could be made for her immediate employment. Such a scheme would also provide a supply of applicants from whom to draw to meet the fluctuating demands of the shop for additional help, while the expense would be negligible.

One general complaint about the employment of women in railroad work that is usually done by men is that women lack initiative. However, it must be remembered that a woman in most cases is absolutely ignorant of the nature of the new work assigned her. In the majority of cases, a woman entering a railroad shop has only a vague idea of what a locomotive is. She naturally knows what it is for and what it does, but she has no knowledge of either the names or the functions of its various parts. A part of the training of women for railway shop work should consist of lectures and explanations not only of the tools used in the shops, but of the machines which are being made or repaired, in order to give these women as broad a point of view of their work as possible.

The people of this country are rapidly gaining a clearer realization of the magnitude of the task of winning this war and the important part that women must play in helping to win it. There will naturally be some doubt as to the ability of women to "make good" in different branches of shop

work; some inconvenience may be caused during the time work is being rearranged so that women can be used effectively; but the patriotic co-operation of foremen and men in instructing and helping those women who are brave enough and patriotic enough to undertake strange work in new surroundings will insure success.

THE FEMALE WORKER IN RAILROAD SHOPS

BY HARVEY DEWITT WOLCOMB

"Are you hiring any experienced milling machine hands?" The questioner was a pretty young lady, dressed in the height of fashion and very much out of keeping with the dusty and grimy shop office. She addressed this inquiry to the general foreman on one of the large eastern roads.

The foreman displayed no surprise at seeing a young woman in such discordant surroundings. This particular company was in need of milling machine hands and by closely questioning the fair applicant, he soon proved to his own satisfaction that the girl—for she acknowledged she was only 19 years old—had a good knowledge of machine work and was competent to handle regular milling machine operations. She was employed on the conditions, to which she gladly consented, that she wear bloomers or overalls, tie her hair up in a tight fitting cap or net, wear safety goggles when operating any machine, remove all jewelry from fingers and hands and last, but not least, wear no gloves when operating a machine.

Six months' actual experience has proved that, if these precautions are observed, the female worker is less liable to accidents than a male workman. This is probably due to the fact the female worker is more careful. In a railroad shop employing women machine operators, for six months a careful record was maintained of 15 new female employees and the same number of new male employees. During this period only one injury occurred to a female employee as against many to the men. It is worthy of mention that the accident which the female worker suffered was of a very trivial nature and was caused by breaking one of the rules of employment noted above.

The safety of male workmen in shops has been neglected and this is one of the very good reasons why the more extensive employment of the female worker should be advocated. The average railroad shop buildings are so situated that the men in charge feel that there is no safe way for women to reach them. If such dangerous conditions exist immediate steps should be taken to correct them. The benefits of the movement to introduce female workers will then react on the entire force employed.

In questioning women applicants for employment, it is surprising to note how many have had factory experience of some nature so that to a greater or less degree, they are familiar with the shifting of belts and realize the danger of coming in contact with moving machinery. This previous experience may be one of the principal reasons why women learn so readily to handle the machines to which they are assigned. At one large shop it was found that after less than one day's time spent in learning how to operate a sensitive drill press a new girl produced as much work as a boy with considerable experience on that machine.

The experience of the large systems that are hiring women in large numbers and placing them in the shops proves that the claims made by some who have not as yet tried this class of help, are groundless. It has been predicted that the discipline of a shop would be lowered, but this has not been found to be the case. In the first place, the female worker should be classed and handled as a "working unit." That is, she should be given to understand she is employed to produce a day's work, and just because she is a woman is no reason why she should be allowed to disregard the rules of the shop. The railroad officer who feels that it is wrong to treat a female worker as a "unit" should visit some of the large factories employing many women where special systems have been worked out to suit the conditions to the workers. As a concrete example, take the question of providing stools to allow the women to sit down while operating machines. The average shop foreman will claim this is unnecessary, for railroad shops have been run for fifty years with every workman standing up, but on the other hand, it has been found that on some jobs the sitting position actually results in an increased output. Some shops have made special efforts to develop, along scientific lines, a stool that will permit the operator to produce the most work with the least fatigue. Much actual shop production has been lost because the traditions of the shop were "to stand up."

Another tradition has been to hire a man and put him to work on his own merit. If he spoiled a job, he was fired, but if he "got away with it," that is, could handle the work fairly well, he was retained. This resulted in keeping the class of workmanship at nearly an equal level, for personal incentive was eliminated; in fact, personal endeavor was not sought. In recent years it has been found that with good instruction, the average workman can improve and increase his production with no extra effort. In placing a female worker in the shop, this should be borne in mind and instruction provided at the start. As a rule, the female, working at a disadvantage will at first endeavor to do too much, and if her efforts are not directed along the right lines, she will soon become discouraged and leave thus making it necessary to break in another employee. The choice of a position for the female worker should be handled with the same common sense as the placing of male workmen.

While the employment of female help has not been as general as it should be, only the largest systems taking up the movement to any great extent, the success of women in shops has been proved and it will only be a short time until all the roads are forced to protect themselves from the shortage of labor caused by men leaving to take up employment elsewhere, or entering the government service. Many of the medium sized railroad shops claim they have no openings where a woman can be used to advantage. In England war necessities have given the government authority to handle labor matters, and the labor bureau has greatly increased production by demonstrating to the manufacturers that by making certain changes it is possible to advance workmen and introduce female workers and so secure the desired production. As yet we have not reached this stage in America.

We have been a peaceful nation so long that it is difficult for us to change our practices quickly to conform with the present needs. The making of the change is an educational process in which the railroads, as centers of influence, can play a very important part, for few industries have entered more whole heartedly into the win-the-war spirit. Railroad labor is scarce, but by a proper rearrangement of workers and the introduction of women, the roads can protect their own interests as well as help out the present critical labor shortage in the industrial field.

THE FIELD FOR WOMEN IN RAILROAD SHOP WORK

BY MISS MARGARET LAMPERT*

It is interesting to observe the manner in which women are meeting the new situation confronting them in the industrial world. They are being given an unusual opportunity to help themselves and their fellowmen to better things industrially than they have dared hope would ever be their fortune. Not only are they given the opportunity to prove their loyalty to their country by stepping into the places so recently made vacant by those who have joined the army or navy, but they are also permitted to prove to the

*Miss Lampert is a former high school teacher who has worked as a lathe operator in the machine shop of a western railroad.

world their ability to cope with the problem so long cherished by man as his peculiar task.

They are already proving their patriotism, for many women are now employed in the railroad shops. Those who have entered the field have shown ability, with eagerness to master the problems met. They receive the inheritance of the same parentage and some of them must therefore possess the same talents as their brothers. The same environment or training added to this same inheritance must of necessity show some women to be as capable as some men in mechanical labors. Prejudice has heretofore prevented their entrance into what has been regarded as man's domain. Now that women are needed in the mechanical world we are learning that they have the powers latent which man has been exercising and developing for centuries. Indications are strongly in favor of their success in coping with man's mechanical problems.

The women who have responded to the call for aid in the shops have come from all walks of life. There are milliners, dressmakers, nurses, teachers, clerks, housewives, hired girls, factory girls, and girls who have never before earned money. Naturally, they come from all classes, from the ignorant to the college graduate, just as do the men beside whom they work. The shop superintendents, however, exercise care in the selection of women for shop work in order to prevent the introduction of the rough element.

The motives inducing women to come to the shops are as varied as are their stations in life. One came because it gives such freedom from the "double standard" of pay that she has met in cafe and factory. Another has come to aid her husband in paying off a doctor bill contracted in his long illness. Still another saw the opportunity to gain practical experience to enable her to teach physics from a broader viewpoint. The chance to serve the country appealed to another. But that none came for the sake of being conspicuous was shown when a local paper wished to take a photograph of the group in unionalls for publication. Without exception these women shrank from such publicity. As one woman put it, "We're not here for exhibition."

Women have met unusual difficulties in deciding to enter shop work. The requirement that they wear unionalls as a matter of safety has kept many women from taking up the work. The men of the families have been most averse to seeing women don "men's clothes" and work amongst the men. As to the disgrace of wearing unionalls, those women in the shops cannot see that it is any more shameful to leave off hampering skirts while about machines than to leave off frills when going to the kitchen. Women wore aprons before the days of butchers and bakers and the latter are not regarded as any less manly because they wear clothing befitting the nature of their work. Articles of colthing were not created with sex, but they were devised as necessity demanded their use.

That the men in the shops do not consider the women beside them disgraced is shown by their respectful attitude toward them in the shops and on the streets. Not only do the men refrain from disrespectful remarks and actions in the presence of women, but they also give friendly and generous assistance when approached by them with inquiries about the work which is so foreign to their past experience. The fact that women begin with the same pay as do men and receive increases as they master the work has been an incentive to a better spirit between men and women. Many men who had objections to the introduction of women because they feared that it would lower their wages have withdrawn them since they find that these newcomers do not desire to underwage them. The presence of women has had a refining influence on the shop men. They are more careful of the language they use. The men working near a woman are always careful to take their bites of tobacco when her back is toward them.

Adequate provisions have been made for the comfort of the women workers. Even before stools were made for them one woman was permitted to use a box as a seat. Another was told by her foreman to sit on the end of her lathe bed whenever possible. A retiring room has been well furnished for their convenience and comfort. They are not, however, permitted to wear gloves to protect their hands for these are regarded as cumbersome and dangerous.

The women have proved that their talents are as varied as are the demands on their resources. One began work on the grinder and was soon transferred to the electric welding room where she is learning this type of work. Another commenced work on the grinder and is now doing piece work on the drill press. Still another was passed from grinding drills to running a shaper and later a lathe and has made a success of each. Two women are successfully operating milling machines, one is threading bolts, still another is working on a planer, and several are engaged in running cranes. So we see that woman's ability is not confined to operating any one type of machine, but she is able to adapt herself to the demands of the situation.

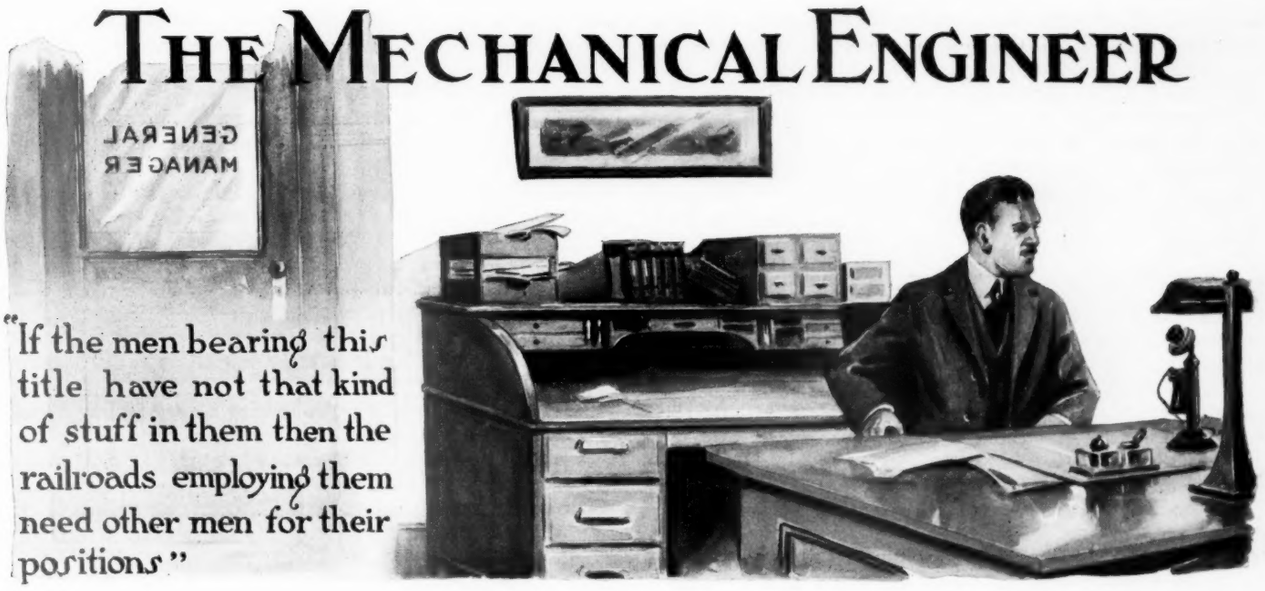
In quantity of work turned out the women are not yet equal to the men. Several have been put on piece-work, but, while they are making more money than they did on day work, none is as yet making as much as the man beside her. This delayed progress is in part due to reluctance to ask assistance in heavy lifting, which is generously given. The lesser quantity of work is to be expected, for until they entered the shops a few months ago women have been discouraged whenever they have shown any interest in things mechanical. Not many men are given the opportunity to try piece-work until they have had considerable more mechanical experience than the women have thus far had, so a comparison of output can not yet be made on a fair basis. In accuracy of work the women are pronounced easily equal or superior to the men. About the second week one woman was working on the lathe her foreman pronounced a dowel-pin she had made to be accurate within a half thousandth of an inch.

As one would expect, women have not yet shown any startling degree of ingenuity. They have been too busy mastering the problems so new to them to give much thought to improvements. That this power is latent is indicated nevertheless by a few cases, for instance, her reticence about asking to have her heavy chuck lifted for her caused one woman to ask for a board that she might lay from the lathe bed to the tool rack so that she might roll the chuck back and forth. As women become more familiar with the work they will doubtless show more ingenuity.

Lack of experience in men's way of working is women's chief obstacle now. The dismissal of two women who were irregular in attendance procured the desired result in added diligence on the part of a few others who were inclined to absent themselves from work frequently. They have learned to begin and close working hours promptly. There is every evidence to lead one to conclude that the women in the shops will unite with the men for the improvement of conditions. They will learn to discriminate between vital and insignificant details.

Women need no longer hesitate to enter the shops because of fear of inability. Nor need they hesitate to train themselves in this field. The foremen agree that "education counts," whether the laborer be man or woman. The woman with ability is placed in an unusually advantageous position. Her recent entrance into the field and the small percentage of women in the shop force make her conspicuous. The men give her all the respect she shows herself worthy of receiving. The nation needs the assistance of women in the shops. Even after the war closes there will be an increasing demand for woman's service to replace the man power rebuilding the war tattered fields of Europe.

THE MECHANICAL ENGINEER



"If the men bearing this title have not that kind of stuff in them then the railroads employing them need other men for their positions"

THE following brief articles were contributed by a number of mechanical engineers in response to the inquiry: "How can the mechanical engineer make his efforts of the greatest possible value to his road in the present emergency?" They present a number of interesting comments on the problems the mechanical engineer has to face, and in them is the suggestion of an ideal conception of the functions of the mechanical engineer in the railway organization which is worthy of the thoughtful consideration of all railway officers.

Although it must be admitted that this ideal has seldom been attained, there is no real cause for discouragement in that fact. If these men will but preserve it and keep it ever uppermost in their own consciousness—then conduct themselves as if its attainment were an everyday occurrence—the time will come when it will be a fact. It must be remembered that organizations shape themselves more or less in conformity with the human material of which they are made.

DON'T BE LIMITED BY A LABEL

Emergency is the parent of opportunity. There was never a time when the opportunities of mechanical engineers were greater or more numerous.

This is an age of engineering, and there is hardly any line of business, to say nothing of technical engineering, that is not to a very large extent mechanical engineering. Unfortunately employers have been too prone to look upon their mechanical engineers as special machines designed for special purposes, rarely thinking they were good for anything else, and more unfortunately, mechanical engineers have let employers "slip it over" on them.

These are critical times of great stress, both moral and physical, and we all hope that they presage the dawn of a new era, an era when men will go forward on broad lines instead of in grooves, when employers and employees will give more attention to analysis of the work at hand, themselves and each other, than to the titles which they bear.

GENERALLY speaking the railroads are getting far less than the highest services obtainable from the mechanical engineers and their organizations.

The reason for this is two-fold:

First.—Lack of vision on the part of the railway managements, of the possibilities of real engineering methods applied to the problems of equipment design, construction and maintenance.

Second.—Too much emphasis on the *Mechanical* and not enough emphasis on the *Engineer*, on the part of the mechanical engineers themselves.

If the mechanical engineer will but clear his own view of his job and its possibilities, then attack the problem with determination, who is better fitted to broaden the vision of the management than he?

The managements are "from Missouri"; engineers are by training especially fitted to do the "showing."

Getting the most value from mechanical engineers is a matter of fullest co-operation of mechanical engineers and their employers. The business at hand at the present time is big and it must be handled in a big way.

Mechanical engineers, equipped as they should be with an analytical training, experience, loyalty and steadfastness of purpose, must eliminate personality and prejudice, do their work and carefully assert themselves with all their might. They must make their employers understand that they are willing to tackle anything and make good, and that their sphere of usefulness is not confined to the limits commonly associated with the label that has been applied to them.

The employers, to a greater extent than heretofore, must co-operate by broader recognition and selection of their mechanical engineers to fill positions of trust and responsibility in *any* of their departments. If they will make a start in this direction, they will obtain results that will surprise them and will open the way for the advancement of a large class of most deserving and patient men.

The government moulds generals out of ribbon counter clerks. Railroads mould mechanical superintendents out of cinder pit laborers and engine wipers, presidents and general

managers out of water boys. Why not presidents and general managers out of mechanical engineers, men who are especially trained to analyze; and after all, analysis is what "does the trick." If the men bearing the title of mechanical engineers have not that kind of stuff in them, then the railroads employing them need other men for their positions.

Summing all this up in a sentence: Mechanical engineers can do the most in this crisis by broadening their fields and by receiving full co-operation in that direction from their employers.

HONESTY, THOROUGHNESS AND DETERMINATION

In order to be of the greatest value to his company, the railroad mechanical engineer should bear in mind the following conditions:

First.—In the highest sense his department is purely one of service. He should form the connecting link between the manufacturer and his company, the purchaser. This implies a spirit of absolute fairness supported by strict honesty of opinion.

Second.—Certainly he should be most careful in making recommendations to see that they are backed up by convincing evidence, both as to operating results and the engineering fundamentals, so that there may be no recourse but to adopt a program once suggested by him. This involves a sound knowledge of economics and requires earnest and untiring effort.

Third.—He should be most determined and he should co-operate with every department concerned in any matter under consideration, representing the best opinion of the mechanical department based on the experience of all its members.

If the mechanical engineer is strong, earnest and clear thinking, his department will be respected and his judgment will inspire the confidence of those who are not engineers. His especial purpose should be to convince, not only his immediate superior, but the executives as a whole that the truth is being sought in every field and that special effort is being put forth, not only to take into account the mechanical limitations, but also the broader questions of cost of operation and capital expenditure.

GIVE THE MECHANICAL ENGINEER UNQUALIFIED SUPPORT

There are well defined laws of science and applied mechanics that have not been followed in building equipment, of which our repair tracks and repair shops hold an abundance of proof. This did not seriously hamper railroads as long as they had a surplus of equipment but since the supreme test of a war involving the civilized world has come, creating demands on our equipment greatly in excess of anything in the history of railroading, these conditions stand out much more sharply, especially so because the railroads cannot purchase new equipment or sufficient material to provide themselves with a comfortable margin in excess of the demands.

The mechanical engineer must therefore face the problem of bringing old equipment up to the highest possible state of efficiency at a minimum of expense and at the same time must plan for future equipment that will *stay in service* and involve a minimum of expenditure for repairs.

The present condition of equipment has been brought about by:

1. The large number of appliances which have come upon the market with good talking points but without the ability to hold out in actual service.

2. The narrow policy of roads in designing and purchasing equipment to meet only the service conditions of their own roads, and in some instances not even that, without taking into consideration that their equipment must go where much heavier service is required.

3. The pressure of a fixed limit of first cost brought to bear on the consideration of many points in construction and in the selection of appliances.

These are conditions that we cannot escape. How, in the face of them, can the mechanical engineer make his efforts of the greatest possible value to his road in the present emergency?

The mechanical engineer must be given the unqualified support of his superiors on all recommendations in which he is right. He should not be over-ruled in his decisions on construction and the worth of appurtenances unless he can be given a clean-cut and valid reason that such action is for the best interests of the road. When he is over-ruled he should always be given the opportunity to verify the decision against him and a right to appeal if he can show that he is right.

Specifications and plans should not be changed without his knowledge or consent. Changing specifications and plans to reduce the first cost should never be resorted to if it weakens the construction to a point below the recommended practices of the M. M. and M. C. B. Association. Such errors have been one of the chief factors in excessive repair costs and loss of service.

He should be conversant with all the rules and regulations that affect equipment, and should work with other mechanical engineers to bring about the best standards possible. He should take an active part on the floor of the M. M. and M. C. B. conventions.

In altering designs to cure failures he should make it his business to get all the facts as to the cause of the failures. It often happens that he is called upon to make unnecessary changes as the failure has resulted from some outside cause having nothing to do with the design.

In designing new equipment he should make every pound of material perform the greatest possible service, owing to its excessive cost and the difficulty with which it is obtained. One of the most noticeable failures in this connection is seen in the design of heavy freight locomotives, carrying 15 to 25 tons of metal around in the shape of trailing trucks that is contributing nothing to the adhesive weight; an exception is seen in the decapod locomotive recently built by the Pennsylvania Railroad. Another item that should have special attention is the center and draft sills of freight cars to see that the construction is as heavy or heavier than that which has been recommended by the Master Car Builders' Association.

In these two items alone there is an unlimited field for improvement. He should spend considerable time on the road, in the shops and on the repair tracks to learn first hand how designs and specifications can be changed to reduce repairs and all unnecessary labor expended in making them. This practice should extend occasionally to foreign roads and manufacturing shops.

Every man on the staff should be a mechanical engineer in the process of making and if possible a mechanic. They should be sent out on the road at least once a month to keep them from becoming machines that will eventually become a liability instead of an asset. They should be encouraged to take the initiative, talk to enginemen, trainmen and repairmen to obtain ideas for the betterment of the equipment. Getting out on the road means more than riding on trains; it is to enable them to relieve the mechanical engineer of many petty decisions that they ought to make for themselves.

The greatest asset the mechanical engineer can have is a determination to conquer and a cheerful disposition that never accepts defeat.

MAKE ALTERATIONS ONLY FOR IMMEDIATE UTILITY

The mechanical engineer's chief concern at the present time is to keep his organization intact, and thereby efficient. Various influences, including the draft, voluntary enlist-

ments, and the sudden increase in the wage scale of draftsmen due to competition from outside sources, has made it very difficult, indeed, to keep our good men with us. Owing to such conditions, the writer has lost a large proportion of his original force, making it necessary to rebuild it at the expense of great effort.

During the present emergency the mechanical engineer should refrain as largely as possible from instituting extensive tests of equipment or materials, as this class of work at this time would tend to interfere with the maximum output of transportation effort.

At the present time the mechanical engineer should keep in close touch with the shopping of equipment, particularly locomotives, making all possible effort toward introducing the small correctives in poor designs, which will not delay the output of the shops, but tend to keep engines and other equipment in service longer after they are out. He should hesitate to introduce any changes in design, unless they are very carefully considered from the standpoint of immediate and necessary utility.

REHABILITATE THE OLD EQUIPMENT

The mechanical engineer's efforts, in order to be thorough and comprehensive, must be continuous. His work, when rightly handled, is less of the routine type and more of the constructive kind. If he is really to be successful in his efforts, he must continue them over long periods of time and not over years or months only. He has duties, which, if properly discharged, must be performed under continuous heavy pressure. These, in a measure, are the reasons why I often wonder that railroad managers fail to recognize the importance of their mechanical engineers.

They are also the reasons why railroad mechanical engineers seldom perform spectacular feats or develop exceptional ideas that bring them into public prominence. Their best work is a gradual constructive piling up of idea on idea, plan on plan, to ultimate completion. Many of the best mechanical accomplishments in the railroad field are the result of this gradual development.

The mechanical engineer must by all means, even more than heretofore, assist his superior officer in solving difficult problems. He must help to make the burden lighter that railroad officers are carrying in keeping trains moving and shops producing increased outputs. He must assist in working out plans for quicker and shorter methods of making repairs for car and engine repairmen. He must seek to obtain stronger castings and better forgings on rolling stock, which may have been overlooked, underestimated or passed over in less serious times. He must, in addition to constructive thought of future equipment, concentrate more strenuously on present failures and weak spots than has ever been done before and eliminate every one of them that possibly can be eliminated. He must locate all types of material that are being purchased in the rough which can readily be furnished fabricated ready to apply; undoubtedly in times such as the present, the railroads should relieve themselves of every possible item of manufacturing work in order to increase their repair output. He must search carefully for any useless or unnecessary stock on fabricated material purchased by the railroad and see that it is removed on future orders.

He should concentrate more closely on what his railroad has, with which it is trying to operate, and not be concerned too deeply with future developments for equipment that is to be purchased after this great emergency has passed. Unquestionably the present time requires the operation of much equipment that would not be repaired in closely competitive years when operating costs are of serious consideration, and therefore the question of proper repairs and reinforcements to this type of equipment should be the mechanical engineer's most serious duty today.

He understands his old equipment and has the best opportunity to recommend betterments. His is the half way station between the shop men, possessed of good ideas, and the head of the department who wants these new ideas. A car or a locomotive that will haul or pull a load if properly reinforced or improved is a valuable piece of rolling stock today and, when we consider the present emergency condition, is so valuable that the mechanical engineer can well afford to assist in keeping every piece in service. The mechanical engineer truly can help and is helping and I am sure his efforts are being felt wherever they are thoroughly understood.

FIRING UP LOCOMOTIVES*

BY ALLEN ARMER
General Foreman, Big Four, Columbus, Ohio

The coal that is used in this locality is bituminous, coming from the fields of West Virginia, Indiana and Illinois. From the results of the laboratory tests these coals are found to be very high in volatile matter, or excessive smoke producers. Harrisburg run of mine coal is used by our company at this time. The proximate analysis is as follows: Moisture, 4.85 per cent; fixed carbon, 50.50 per cent; volatile, 37.80 per cent, and ash, 6.85 per cent.

Anthracite or semi-smokeless coal is not available in this locality, and in order to minimize the smoke problem, it becomes necessary to direct our efforts toward the manner of building and handling the fire. Due to the different weather conditions from day to day, the smoke generated in building fires in the roundhouse is variable. The application of the brick arch has proved to be of great assistance in smoke elimination.

From a roundhouse foreman's standpoint, the largest and most important factor is the method of handling the operation. The operator must be thoroughly familiar with the results desired and should know how to handle the fire to obtain them. The fuel must be properly placed to allow the correct amount of air to pass through the grates and the bed of the fire. If there is not enough air introduced into the firebox the gases are driven off the coal containing a high percentage of carbon, thus causing dense smoke. If the supply of air is too great, the gases pass into the stack before combustion takes place.

We have tried various methods of building fires in locomotives to eliminate smoke as far as possible. The following method is the most successful.

The grates are covered with coal banked along the side sheets to a depth of approximately 15 in., and 20 in. at the door sheet, allowing the fuel to slope gradually toward the center. This leaves a light bed of fuel in the center for the proper admission of air. Dry shavings are then placed on top of the coal, and enough more coal added to keep the shavings in place when the blower is applied.

It is important to start the fire at the rear of the firebox, as the action of the blower will draw it ahead. To light the fire oily waste is dropped inside the door, and a light blower is at once used. The fire is allowed to burn until it is well started, and the draft is then gradually increased. In a short time, under ordinary conditions, the coal is ignited, and there is a good fire over the entire grate area. A strong blower is an important factor in reducing smoke.

If the coal is properly placed and of sufficient amount it will not be necessary to add more until the engine leaves the roundhouse, unless the boiler has been filled with cold water. This will give approximately 100 lb. steam with a boiler full of cold water in one hour and forty minutes. With the boiler full of hot water and no steam pressure, the engine can leave the house in one hour. With this manner of firing we do not get over a No. 2 smoke at any time if the blower is properly used.

*From a paper read before the annual convention of the Smoke Prevention Association.

TIPS FROM CHIEF CLERKS TO SUPPLYMEN

Help the Railroad Officer—
He Needs You,
But Conserve His Time

THE EDITOR received in the morning mail a few weeks ago a letter from the chief clerk to a master mechanic telling of the mistaken idea one supplyman had of how to do business in a railway office. The first impression was that the experience was an unusual one; the next thought that it might be well to check it up with the experience of other chief clerks. A dozen chief clerks to mechanical department officers were therefore asked for frank expressions as to their experiences. The letter which caused the discussion follows, as well as abstracts from several letters which were received from other chief clerks.

A BAD START

BY A MASTER MECHANIC'S CHIEF CLERK

Recently a gentleman, well-dressed, entered a master mechanic's office in a more or less excited state, approached the chief clerk's desk, making inquiry for the master mechanic in the following manner: "I would like to see Mr. Jones."

The chief clerk, after realizing that he had a very excited mentality and uneducated mind to deal with, calmly replied by saying, "Mr. Jones is out in the plant and will probably return to the office about eleven o'clock."

The impatient reply was, "I can't wait until eleven o'clock, as I have got to see Mr. Jones right away. What kind of looking man is he, and I will go out to find him? Where had I better go to find him?"

The chief clerk had no idea of permitting him to go anywhere in the plant until he made himself known and the nature of his business. With the idea of allaying the man's impatience, and playing for time, the chief clerk remarked that he would probably want a pass to go through the shop.

"Oh, no, I don't need a pass, as I am an old railroad man and was once a master mechanic. I know all about a shop."

The chief clerk replied by saying that recent instructions had been issued not to permit any one in the shops without a pass, and, of course, a pass could not be furnished unless the visitor would give his name and state his business.

The reply came quickly, "My name is Jacobson, I was for a long time master mechanic of the Sussex division of the A X P Railway."

The chief clerk replied by saying, "I presume, Mr. Jacobson, you are not now employed by that railway."

"No, no, I am now with the Ozark Tool Co., and want to see the master mechanic, also to see your general foreman and tool room foreman, as we have a number of our tools on your road."

This was all the information the chief clerk needed to issue the pass, but it took digging to find out from the man his name and the nature of his business, without appearing abrupt or discourteous, because it was absolutely necessary to obtain the information before the man could be permitted to enter the plant. By having to dig this information out of the traveling man it took up practically thirty minutes of the chief clerk's time and delayed Mr. Jacobson in obtaining an interview with the proper officials.

The traveling man can save himself and chief clerks, or other clerks, when desiring permission to see railroad officers, a lot of trouble and time by the simple little method of presenting their cards or explaining their business immediately on entering offices.

A WISE railway supplyman studies to get the good will of the secretary, chief clerk or clerk whom he must first approach in asking for an interview. These men are usually in the confidence of their superiors and it is part of their duty to help conserve the time of these men and protect them from needless interruption. Courtesy and tack are, therefore, essential in dealing with the chief clerks.

In these days of heavy traffic and extraordinary demands on the motive power and car department officers it is more than ever necessary to conserve their time. The late L. R. Pomeroy used to say that he never visited a railway office unless he was "dead sure" he could leave something in the way of data or suggestion that would be of a distinct help to the officer. Supplymen should get the spirit of this and be as thoughtful and considerate as possible of the officers with whom they have to deal.

"OLD HEADS" TOO MUCH AT HOME

BY A MECHANICAL ENGINEER'S CHIEF CLERK

As a rule, I do not consider the railway supplymen thoughtless or inconsiderate. There are, of course, exceptions to all rules, but, taken as a whole, I doubt if any fair-minded jury would find the supplyman guilty on very many counts. This is not snap judgment, but an opinion based on an experience of eight years. I have noticed the exceptions are usually made up of "old heads" in the game; those who have been making the "rounds" for years and feel that a certain privilege should be accorded them in railway offices by reason of their seniority and long association.

The young, inexperienced man very seldom makes a break of this kind. He is careful as to his movements and only anxious to learn the "ropes" so that he may abide by the requirements of the individual offices he visits.

WHY NOT CULTIVATE CHIEF CLERKS?

But why shouldn't the supplyman be courteous, considerate and continually making an effort to cultivate the good will of chief clerks and others about the office? It is surely a part of his job; and in a way an investment for him. While being courteous to some lowly railroad clerk by a supplyman does not indicate that a lengthy order is forthcoming or that a seed has been sown by which one might sprout, the way is paved for smoother travel on his later trips.

CHIEF CLERK NOT AN ENTERTAINER

The traveling man should not consider it the duty of any chief clerk to entertain him while waiting his turn to be called into the private office. The clerk's duty ends when he has seen to it that the caller's card has been presented to the superior officer and an answer returned. The "peddler" should not insist on discussing yesterday's score, the Italians' successful stand against the German attack or other interesting subjects.

On the other hand, it is up to the chief clerk to see that any caller entering the office is given attention, whether he be a "peddler," book agent, life insurance agent, or what not. No one should be allowed to "cool his heels" until some self-important clerk stops his blatant dictation long enough to find what is wanted. It has been my observation that the more harmony you can create, the bigger your caliber. Such treatment by a clerk certainly does not improve his stock with the caller, or increase his popularity in any way.

VALUE OF SUPPLYMAN TO COME

BY A S. M. P's. CHIEF CLERK

So far as my knowledge goes, the relations between this office and the supply fraternity have always apparently been of the pleasantest. This, no doubt, comes about by the fact that in my early experience with the supply fraternity, our office organization was instructed very thoroughly as to the value to the railroad company of visits by supplymen; that to a great degree, the time they spent with us was not wholly of value to them, but to the railroad company; and that to a great degree, supply men were serving the railroad company as they were serving their employers. Therefore, they should be treated with the same courtesy that would be extended to railroad associates. We have found, naturally enough, that supplymen would at least meet us half way so far as courtesy and service are concerned, and in some cases, the benefits derived through their assistance, I am frank to say, have been not only desirable to the railroad, but beneficial as well.

It has always been our motto, that "More flies are caught with molasses than with vinegar," and it is my experience that similar sentiment prevails throughout the supply fraternity. If this condition were made a practice, there seems to be no reason why it should not work out to the mutual benefit of the railroads and supply men.

THE BOTHERSOME SUPPLYMAN

BY A MECHANICAL DEPARTMENT CHIEF CLERK

The supplyman who does annoy me, is the one who comes into the office and stands around ostentatiously until waited upon, no matter how I may be occupied. Many times, while I am talking on the 'phone or have a stenographer sitting at my desk taking dictation, or perhaps while in conference with some one at my desk, a supplyman will walk into the office and, instead of sitting in the place provided for them, will stand conspicuously until waited upon. Some of them will stand, and wait, and wait.

I often feel like telling them, rather sharply, to sit down and wait a few minutes; but I have never had any words with them about it. It seems to me that all supplymen should understand, when they call at an office, that if the chief clerk is busy they should be seated and wait a few minutes until they can be waited upon.

However, I really do not have any criticisms to make, and as a rule I receive fairly good treatment from all supplymen; and, in return, I endeavor to treat them as I would like to be treated.

SHORT AND TO THE POINT

FROM AN EASTERN CHIEF CLERK

From my observation, courteous treatment from either side produces a like feeling on the opposite side.

MR. SUPPLYMAN, WHICH SYSTEM DO YOU FOLLOW?

BY THE BOSS'S SECRETARY

Which system do you use and what success do you have?

"Here is my card. Shoot it in to the boss. Smoke this after lunch—my favorite brand. I'm in a hurry, so help me out, old sport!"

Or——

"I have something of interest for Mr. Blank, the superintendent of rolling stock, and I am very anxious to see him and will appreciate your assistance. Would you mind taking my card in to him?"

DON'T GET IN WRONG WITH THE SECRETARY

It is probable that the method of approach to the secretary is more responsible for the success or failure of the traveling salesman than any other one thing. You must first get by the secretary or your ability to sell your goods will be of no avail, for you must get an audience with the man who buys.

As a secretary to a mechanical department official on a large trunk line, I have given this problem more or less thought, and with the feeling that I may be able to bring about a better understanding between supplyman and secretary, I will offer my conclusions.

The successful salesman is reputed to be a "hale fellow well met," and the first instance mentioned above covers an individual who is all of that, plus. It is an exaggeration in every respect, and there are two great qualities (in my opinion, two very necessary ones) that are entirely missing: Courtesy and tact. If you had called a number of times before and had learned the characteristics of Mr. Secretary you would probably feel justified in addressing him in this way. It has been my experience that by way of introduction to the secretary, a great many salesmen use expressions similar to the first mentioned.

The secretary may not be an "old sport," and it is possible that he does not smoke, and isn't interested in your favorite brand. Speaking about smokes, let me tell you the way one leading mechanical department official looks upon the proffer of a cigar. I will use his own words: "These peddlers that try to get by through the offer of a cigar are

certainly following the wrong system." Until the cigar was offered the caller was a supplyman and not a peddler. Last, but not least, the secretary is human, and the first thought that strikes him is "I wonder who this guy thinks he is, and if he feels he can put it over me as easy as that?"

Now, take the business-like, courteous method employed by the second man. You immediately get the impression of a quiet, determined business man, one who you know if passed in will briefly offer his proposition, won't be "running off at the mouth," and will not take a minute more of the boss's time than is absolutely necessary. And further, he has placed himself on an equal footing with the secretary, which is of importance when considering the "human interest" feature.

Just place yourself in the secretary's position. The boss is very busy, and does not want to be interrupted very much this morning, and any interviews would have to be short ones. Two supplymen come in at the same moment, one being of the effervescent kind, and the second, of the solid, sincere kind: The boss has just said, "short interviews." Which one would you send in, and to which one would you suggest, "Try it again some day and I'll see what I can do for you."

Another instance: Mr. Secretary looks at his appointment sheet for the day and finds an interval of twenty or thirty minutes with nothing booked. The "talkative" one comes in and wants to "Go over the top." Mr. Secretary says to himself, "If I let this fellow in he will take up too much time, and will upset the program for the day"; and again, a suggestion to the supplyman to try again.

The foregoing refers to the supplyman who is making his first call.

AFTER THE FIRST CALL

If I were a supplyman and wanted to make a subsequent call, I should resort to the telephone and endeavor to make an engagement through the medium of the secretary, or better still would respectfully request the secretary to let me converse with the officer and try and make my own engagement (the personal or human contact again). I would briefly state my purpose for wanting to see him and assure him that I would only take up a few minutes of his time.

I should also endeavor to learn if the officer had just returned from an absence from the office or was contemplating going out on the road, as I would not press for an interview the day before nor the day after. (The officer is as anxious to keep up his work and must find time to carry it on.) Neither would I call on Saturday or Monday. Saturday is a short day and Monday one must get rid of Sunday's accumulations and get the program started for the week.

When dealing with the secretary, do not doubt him and figure that for personal reasons he won't pass you in. If you are suspicious of getting a "raw deal," and he learns of your suspicions, and finds you are trying to get by without him "fixing" it for you, you are liable to a little sharp practice.

"A BAD BREAK"

It is only last week that I received instructions early in the day that for the morning, at least, there were to be no interruptions, the previous day being given up largely to supplymen. My instructions covered 'phone conversations also, and only on company business was I to put the boss on the wire. He was checking over specifications on new equipment—a big as well as a tedious job.

I received a 'phone call about 8:45 A. M. from a representative of a large supply house. He first wanted to talk to the superintendent of rolling stock, and I courteously informed him this was impossible because of a conference. His second request was for an appointment that morning, to which I was forced to reply in the negative. Then he wanted to come in for an interview in the afternoon, and I told him that he might come down, but I could make no promise as to getting him in for the afternoon program had not yet been laid out. He hung up in a "huff," but between then and noon called four times, making exactly the same requests and getting the same answers each time.

About 1:30 he came in and very gruffly requested an interview with the superintendent of car department, and I promptly passed him in, as that official was "entertaining" that afternoon. He lost not a moment to complain that I was indulging in sharp practice, and I am glad to say that I was immediately given an opportunity to repudiate his statement, as the superintendent of car department immediately called me in. Suffice to say, he didn't get in to see the superintendent of rolling stock, not because of his actions, but merely because it was impossible. He left a "sadder but wiser" man.

Now, if you were the secretary and this same party later on endeavored to get an interview, would you give him the benefit of the doubt?

DEALING WITH THE BIG BOSS

Well, anyway, you finally get by the bodyguard (secretary) and he is holding the door open for you to go in.

I believe you should be even more careful of your approach to the boss than to the secretary. You are now before the railroad representative that has the voice in the matter of accepting or rejecting your proposition.

By all means use courtesy and tact.

Greet him courteously, but not effusively.

Don't slap him on the back and tell him his old friend, so-and-so, was telling you what a good scout he was. (He might have been a good scout to his friend who was not trying to sell him something.)

Don't wait for the first opening to say, "That reminds me of a story I heard a few days ago." (The boss might have heard the story, or it might be too putrid for him; besides, stories require time in the telling.)

In other words, get right down to the purpose of your visit. Tell him in as few words as possible just what you have, its purpose, saving, etc. Be protected by models, prints and photos. Don't be too technical, as ofttimes the man you are talking to is a practical man without a technical education, and you will lose his interest by going "too deep."

Above all, be thoroughly familiar with your product. Don't let him ask a question you cannot answer. Your cock-sureness will be communicated to him, and your uncertainty will likewise be communicated to him.

Meet his arguments by going him one better, always remembering that you are talking to a man who has reached the apex in the mechanical profession on his road, and that you can't put over him any "wild-cat" statements or figures. As he would doubt you, so will he doubt your goods.

One of the most successful salesman I know of has for his motto, "Don't knock the other fellow or his goods." He says, "I have something here as good as the other fellows, can give it to you just as cheap, and all I want is a share of the business," and he usually gets it. He is sure of himself in the first place, and sure of his product in the second.

Read the daily papers and keep up-to-date: The boss may feel in a mood to visit, and naturally the conversation will drift to current topics.

You want to leave some impression of yourself behind you; something that will instantly bring you to mind at a subsequent visit; something of your character. You want to be welcome on your next entrance, and the impression you make on your first visit will govern your future intercourse.

YES, BE PERSISTENT

I assume that supplymen reading this will come to the conclusion that they couldn't make a sale if they followed my suggestions, as I have not mentioned "persistence," the greatest factor in making a sale. In my estimation, a successful salesman is one who is chuck-full of persistence. Persistence, however, is truly a virtue until through persistence one becomes obnoxious.

LOCOMOTIVE MAINTENANCE PROBLEMS

THE exceptional conditions under which the railroads have been operating since the United States has been at war, have created new problems in every department. The special problems of locomotive maintenance which have thus been created have to do with the necessity for increasing the number of locomotives available for service, without the ability to supply the increased demand by purchasing new ones, and the obvious requirement that these locomotives be supplied in shape to develop their full capacity in the movement of tonnage. The special nature of the problems lies in the fact that these increasing demands must be met with depleted forces and in the face of a most difficult material market.

In the following paragraphs, contributed by a number of officers who have been dealing at first hand with these problems, are set forth some excellent ideas as to effective means of overcoming the handicaps under which maintenance work must be conducted.

HOW CAN locomotive shop output be increased and the time out of service for repairs be decreased when labor is scarce and material hard to get?

Shop scheduling has helped materially; so has the right kind of training of the unskilled men who replace some of the many skilled men lost by the railroads. Spare fireboxes have cut down the time of heavy back shop repairs.

The extensive use of scrap in many cases has saved the material situation, and also much money.

Welding in tubes and firebox seams has done much to eliminate boiler repairs and keep engines in service.

There is evidence that superheater repairs are being neglected. This leads to loss of capacity and waste of coal. It destroys the investment value of the superheater and should not be tolerated.

SHOP SCHEDULING INCREASES OUTPUT

BY F. J. HARRISON
Superintendent Motive Power, Buffalo, Rochester & Pittsburgh, Du Bois, Pa.

The scheduling of engines through our shops is working a remarkable and wonderful change. During the month of November we put 23 engines through our Du Bois shop after receiving heavy repairs, and on Thanksgiving Day the shops were closed tight all day. We are endeavoring to build this output up to an engine a day or 26 engines for the 26 working days of the month. The November output is an increase of three or four engines a month over previous output. It can readily be seen that the stores department is kept busy getting the material for the increased output and until such time as we have the use of two new shops we are erecting, one at East Salamanca and one at Rikers, we will have to continue to give special attention to our organization, our engines and cars. The desired result can only be accomplished by close supervision and harmony among our officers.

We have been welding in flues for the past several years and are running them the full three-year limit. We have three engines in service that have fireboxes welded in, no rivets at all being used on the sheets, with which we have had wonderful success, and from December 1, 1917, will weld in all of our fire-boxes.

We are also assigning our engines, passenger, freight and switch, and are satisfied that this is going to make another big improvement. Some days we are dispatching 10 and 12 more engines than are owned by the company, on account quick service at our shops.

DO ONLY NECESSARY WORK

BY A. M. DARLOW
Assistant to President, Buffalo & Susquehanna, Buffalo, N. Y.

The number of locomotives in the shop can be reduced effectively by not tearing down and doing unnecessary work on locomotives. Every motive power man knows that when a locomotive is taken into the "back shop" for general repairs a lot of extra and perhaps unnecessary work is done to relieve the shop superintendent of any criticism.

It would be better to reduce the number of engines held in

the shop for general repairs by not doing so much heavy work on all the locomotives that come into the shop, and the work could be done with the smaller forces available. In large shops where a traveling crane is available, it would be better to remove wheels, turn tires, crown out the driving boxes, apply new rod bushings, and a partial set of tubes. In small shops where only a drop pit is available, the main wheels should be dropped, the tires shifted or renewed, the rod bushings renewed, a partial set of flues renewed, that is, the engine should be given a roundhouse overhauling. This should be of such a nature that the locomotive may be kept in service for from three to six months longer.

At some terminals locomotives are awaiting shopping for necessary heavy repairs. Make room for them by keeping out of the shop engines that can be kept in service by giving them light shop or round house repairs. In this way more engines may be repaired and kept in service.

ENCOURAGE INITIATIVE

BY L. A. NORTH
Shop Superintendent, Illinois Central, Burnside, Ill.

One of the first requisites of the maintenance of equipment in such a condition that it can be worked to the very limit of its capacity is the use of material possessing strength and wearing qualities suitable to the demands that will be made upon it. Then secure good reliable workmanship in the erection of this material. Patch work is only a makeshift at any time and will be costly if practiced for any length of time.

We have found that by encouraging the employes of the different departments that the productive capacity of the shop has been increased. It is the practice to personally interview the various employes and encourage them to develop tools which will assist them in the performance of their duties. Some of the ideas developed by them have been a means of reducing their manual labor to a great extent, as well as a great benefit to the company.

It has been our practice where an employ makes a suggestion of this kind, to allow him to build and develop his idea, where possible to do so, furnishing him such assistance from the other departments as is necessary.

The foremen have also been encouraged to make suggestions for the re-locating of shop tools, in order to avoid any back handling or congestion in the movement of the work through the shop.

Shop tools have been re-located, new tools of greater capacity purchased, and new crane facilities installed. Furnaces, steam hammers and other equipment which made possible a quicker handling of work have been added. We have taken advantage of the oxy acetylene cutting and welding process as well as the electric and Thermit welding processes.

TRAIN THE NEW MEN

BY E. V. WILLIAMS
Superintendent Shops, Buffalo, Rochester & Pittsburg, Dubois, Pa.

Increasing productive capacity in the maintenance of equipment while not a particularly new subject even at this time, is still a matter requiring vastly more attention from supervising officers than ever before. We have lost a number of skilled men through the army draft and the allurements of manufacturing plants, and, in order to replace them, have had to take unskilled laborers and train them in the various departments. To do this we have enlisted the services of our apprentice instructor and the various foremen, with such gratifying results that, while not having been able wholly to make up the losses, we have so far been able to hold our own and in some cases to effect a slight increase in production.

We have impressed on the minds of our foremen and subforemen the necessity of giving close attention to the conservation of material, with the result that many items which had always been made of new material are now made of second-hand or scrap material, or are fashioned out of an article discarded from some other job.

A close check on all requisitions for new material, to learn the reason for ordering it and the condition of the part to be replaced, and an effort to have a less costly material used when consistent with specifications, frequently results in the cancelling of requisitions.

The introduction of a system of scheduling engines through the shops, limiting the number of engines in the shop for repairs at one time, and an intelligent report to the shops of the work required on each engine before it is placed on the pit, has resulted in an increased output and has reduced the time that engines are out of service fifty per cent. The engines are delivered for service regularly throughout the month instead of being turned over for service in bunches.

The number of devices and tools for increasing production and decreasing costs, as well as simplifying operations, has increased wonderfully as a result of constant co-operation of the foremen and men. The creation of a new position, that of supervisor of tools and machinery, who devotes his entire time to the working out of such devices and the economical placing of machine tools to minimize cost of handling, is one of the most valuable moves that could be made.

The placing of miniature or sub-storerooms in various departments, where a stock of much used small articles is kept, reduces the time the men are away from their work; and the practice of the stores department of collecting all material orders and delivering material to selected central stations is another powerful factor in increasing production.

Last but not least, the bi-monthly staff meetings where a full and free discussion is had concerning all things connected with the shops, bringing to the attention of all the costs of various operations and interchanging views on each subject, taking up engine failure reports in detail, the causes, delays, costs of failures and results of investigations, reports of train movements, loading and tonnage, and all matters relating to the service in all branches, loading and unloading and prompt release of cars at company's terminals, not confining any subject to any particular department, and interesting all in the value of "head work" has wonderfully stimulated the entire organization with very gratifying results.

UTILIZE SCRAP MATERIAL

BY C. L. DICKERT
Superintendent Shops, Central of Georgia, Macon, Ga.

We did not realize fully what economy meant until we were forced to it through necessity, brought about by high price and scarcity of material. In normal times before the war, material prices were low and material plentiful and could be gotten from the manufacturers in thirty days or less after being ordered. Now deliveries, if promised at all, are from 12 to 24 months, with prices almost prohibitive. But the railroads must run; therefore it is necessary that they have material to keep their power in good condition to handle the business.

To meet these conditions, we are utilizing every piece of scrap material wherever it can be used, reclaiming worn and broken parts of locomotives and cars by acetylene and electric welding and rolling scrap material into round bars for bolts, reinforced concrete bars and other stock where round iron is required. All scrap car axles are drawn out in the smith shop for making coupler yokes, truck arch bars, draft keys, etc., no new material being purchased for these items. All carry irons and straps for draft gears are made from scrap coupler yokes. Old yokes are removed from couplers,

straightened out, cut to length and formed under a hydraulic press in the smith shop.

We have just completed building 100 40-ton, 40-ft. wooden stock cars at Macon shop. Second hand material or material developed from scrap was used for the couplers, coupler yokes, draft bolts, carry irons, straps, striking plates, brake cylinders, brake cylinder brackets, washers, brake beam safety bars, pull down rods, brake rods, push rods, pipe clamps and release rods. The axles, trucks, truck bolsters and couplers were taken from an accumulation caused by the destruction of condemned equipment for some time past. The collars on the axle journals were built up with the oxy-acetylene torch and then turned to M. C. B. standard.

Parts developed from scrap material and second-hand material used in connection with freight car repairs are numerous, and the locomotive department comes in for much reclaimed and second-hand material.

Piston rods are made from scrap car axles, where the make of the material is known; crank pins from scrap driving axles and knuckle and wrist pins from scrap piston rods and axles. Side rod bushings removed on account of wear where pins are worn are used when new pins are applied. All globe valves are sent in from the system to the Macon shop for repairs. Scrap brass, such as injector steam rams, dowel plugs removed from driving box brasses, etc., are used in making small brass parts. Scrap boiler tubes are used for making locomotive pilots, coal gates, punching cut washers and bracing steel coal car sides. Scrap boiler plate is used for rod liners, shoe and wedge liners and cut washers. All oil cans, hand lanterns, caboose lamps, engine water coolers, switch lamps, semaphore lamps, markers, etc., are sent to the tin shop, repaired and reissued. Old I-beam car body bolsters removed from condemned equipment are cut up with the acetylene torch; the center is used for striking plates on cars; the flanges are used for stiffening strips on steel dump car doors. All nuts are assorted from scrap, retapped and used on freight cars. All brake beams are straightened and new fittings applied where needed. Where brake beam or T- or I-beam shapes are too light for further service, they are split in shears and used for brake beam safety bars. Cotton waste used for wiping coaches, shop machinery and locomotives, is washed and used over again, effecting a great saving. Frogs and switches are repaired and made new at a great saving, using new and relay rail. The packing for frogs is made from scrap, drop forged to shape for the different sections of rail. Clay and tamping picks have new ends put on and brought up to standard size. Spike mauls, cleavers and spike bars are reworked. All track wrenches are drop forged from old driving tires. Switch lugs are made from scrap boiler plate.

Locomotives for all classes of service—passenger, freight and switching—are being superheated and equipped with power reverse gears.

BUILD SPARE FIREBOXES

BY F. W. TAYLOR
Superintendent Motive Power, Missouri, Kansas & Texas, Dennison, Texas

In the locomotive department the general repair shop should be organized to co-operate with the supply department in such a way that the locomotives receive repairs in the shortest time possible. The men should be encouraged to do good work and machine tools speeded up to their full capacities; labor saving devices should also be installed. It would seem that to expedite engines requiring new fireboxes, an extra gang of boilermakers be put on to build new back ends complete, so that when engines arrive at the shops, the old back end may be disconnected from the barrel at the throat and the new back end applied. Ordinarily the application of a new firebox requires holding an engine about six weeks, but by having back ends ready ahead this work can be accomplished while the machinery is being overhauled, which takes about two weeks. By this method the railroads have about one month additional service from the engine.

Money spent for back shop facilities and for kinks developed in the shop is a good investment and should be encouraged by the officers.

The routing of work plays an important part in expediting repairs, and this should receive thought and action.

DON'T NEGLECT THE BOILER

BY E. W. YOUNG
General Boiler Inspector, Chicago, Milwaukee & St. Paul, Dubuque, Iowa

For keeping the locomotive boilers in the best of order with the least expense in these days of scarcity of the most necessary materials and labor, frequent and painstaking inspections, coupled with the old grandmother's proverb, "A stitch in time saves nine," comes as near to a satisfactory solution as anything that can be done.

A thorough and careful inspection at frequent intervals will lead to the discovery of slight defects which can be repaired at slight expense and be the means of avoiding heavy repairs later on. A patch on the boiler will save many dollars for new material that will have to be bought later if the trouble is not immediately attended to. Looking for and finding the little faults, and never overlooking them because they are too insignificant to justify remedying them, is a sure means of avoiding big troubles.

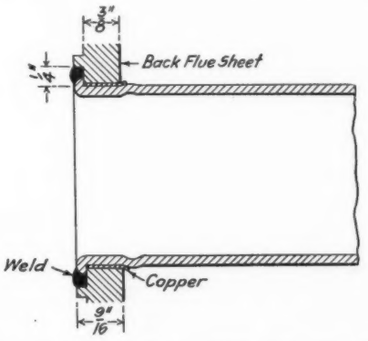
Inspect often, find and remedy the little irregularities as soon as they make their first appearance. Then large repairs will rarely be necessary. This will work for the greatest economy and give the most satisfactory service from the power.

KEEP BOILERS FROM NEEDING REPAIRS

BY GEORGE AUSTIN
General Boiler Inspector, Atchison, Topeka & Santa Fe, Topeka, Kans.

The sketch shows an experiment that so far shows very favorable results. It was tried as a means of reducing the accumulation of clinkers or honeycomb on the flues, which on some divisions is very troublesome. The engine on which this was tried has been in service since last July and reports are very favorable.

In this case an old tube sheet was used, that is, it was pretty well worn at the holes before the counter boring



Method of Welding Tubes in the Firebox to Prevent Honeycombing

was done, it was then bored to 3/8 in. thick, copper ferrules were applied, and tubes swedged and expanded with a sectional expander for a 3/8 in. sheet. The tubes were then beaded and welded as shown.

In my judgment more good can be accomplished by educating the engine crews and engine handlers to prevent the necessity for repairs and by improvements in feed water

conditions and eliminating corrosion than by considering short cuts in making repairs.

I would rather find one way that will reduce or prevent the necessity for repairs than a dozen ways of improving the methods of making repairs.

ELECTRIC WELDING REDUCES BOILER REPAIRS

The Norfolk & Western for several years has been developing the use of electric welding in its boiler shop work. In 1914 a locomotive was placed in service with a welded firebox. The wrapper sheet was continuous and the flue sheet, door sheet and firedoor opening were all welded. No rivets were used except through the mud ring. The firebox corners were welded to the mud ring for a distance of about six inches around each corner and both the tubes and superheater flues were welded to the back tube sheet.

This locomotive has been in service for over three years, and during that time has not had a boiler failure. During the first year of this period the total cost of boiler maintenance was $2.93.

All tubes on the Norfolk & Western are being safe-ended by electric butt welding, three machines doing all the work for the system, which operates nearly 1,000 locomotives. The work now done on one of these machines formerly required four coke fires and as many welders. In addition to the reduction in the cost of safe-ending, about two-thirds of the shop space formerly taken up by the four coke fires has been released for other use.

KEEP SUPERHEATER FLUES OPEN

In order that a locomotive boiler may evaporate water, it must be so constructed and maintained that the heat liberated in burning the fuel on the grates can be transmitted, with as little loss as possible, to the water in the boiler. The tubes are provided in the boiler for the purpose of carrying the hot gases given off from the fire, in the closest possible proximity to the water, so that rapid evaporation will take place. If the boiler tubes become stopped up from any cause, gases cannot pass through them. The result is, of course, a poor steaming engine which is unable effectively to haul its tonnage and causes delays, not only to its own train but to others, by stalling and having to double grades. In the case of the locomotive using saturated steam, plugged flues are bad enough, but in the superheater locomotive the conditions are aggravated because, not only does the lack of the necessary heat in the tubes cause a falling off in the amount of water evaporated into steam, but the steam itself, in passing through the superheater pipes, does not receive its share of the heat from the gases and consequently does not become superheated.

The superheater, as applied to a locomotive, materially increases the drawbar pull for each pound of coal burned. It follows, therefore, that if the superheater is shut off from the action of the hot gases by the large flues being plugged with cinders and soot, the locomotive is not going to show the performance which it should.

With the shortage of help in shops and roundhouses so acute as it is under present conditions, there is a tendency to let get by without attention those matters of maintenance and repairs which may seem the least important; but flue cleaning should not be classed among these. A locomotive may not be in the best condition as regards its machinery, and still it will give a good account of itself in getting the tonnage over the road if the boiler work is properly done, and particularly if the flues are thoroughly cleaned out and kept clean at all times. If the flues are kept clean in superheater locomotives the superheater can be depended on to live up to its effectiveness under the most severe conditions. In cleaning flues, it is not satisfactory to shove in a rod for two or three feet from the firebox end. The flues should be blown out thoroughly with compressed air, preferably at a pressure of about 100 lb. per sq. in. If this work is done at the end of every trip, it will require a minimum amount of labor and will insure the flues remaining clean and the locomotive will always develop its maximum power.

THE IMPORTANCE OF SUPERHEATER MAINTENANCE

BY H. T. NOWELL
Assistant Superintendent Shops, Boston & Maine, North Billerica, Mass.

Many articles have been written on what should be done to properly maintain our locomotive superheaters and there probably is not a railroad man, in the mechanical department at least, who has not had the subject thoroughly drilled into him and has passed it on to the next in line. But do we maintain the superheater properly today with the excessive business that has been forced upon the locomotives? On many railroads, certainly not. Still we continue to expend thousands of dollars on new installations to old power and not a cent for the proper organization for supervision to see that those already installed are properly maintained.

The repair shops have certain well defined rules for the overhauling of the equipments, carried out while the locomotives are undergoing general repairs, that put the equipments in as good condition as when new. The engine houses also have rules which have been formulated from experience and careful tests that will give the best locomotive performance, but these are often neglected under the present severe operating requirements.

In talking recently with a man who has just completed a tour of many of the eastern roads, investigating the general superheater conditions, he said that the practices in the engine houses were not as good as they were three years ago, citing cases of plugged flues, locomotives fired with dampers tied up, and the general indifference to the importance of the whole subject, causing poor locomotive performance and damage to the equipments.

Conditions were better in the past when the superheaters were new. Engine house foremen were interested as it was a new subject; officers higher up kept it "alive," and employees having the direct care of the superheater engines gave them the necessary attention because they had been properly instructed. Since that time, these employees have gone "over there," or passed to other duties and the men filling their places have gradually drifted into wrong or indifferent practices.

Mechanical department officers are allowed thousands of dollars by their managements for new superheaters, as the argument is advanced to them that these equipments pay for themselves in a short time in the saving of fuel and increased hauling capacity, and this they do on the basis of the first few weeks' performance or when they are properly maintained. How much money are the mechanical department officers allowed per year to efficiently supervise the proper maintenance of these equipments?

We all know that the superheater locomotive boiler in poor condition is not as efficient as a saturated steam boiler that is in good condition, so it is doubtful if anywhere near the savings are made that are promised. Here is the condition of many superheater locomotives as they arrive at the shops for repairs:

1. Superheater damper wired up or fastened open. When put on the test rack, they are found to be working properly in nearly all cases.
2. Brick arch loaded with ashes and slag, plugging the lower flues. Appearances indicate that they have not been down for at least a month.
3. Half the superheater flues plugged solid so that flame from an open torch will not draw into the flue with the blower on. The result is that the ends of the units are badly burnt, also that the locomotive has not been getting the superheated steam, to secure which the management has invested $2,000.

Complete instructions are issued with the superheater for its care and maintenance, but the problem will never be solved until the railroad managements put on enough supervision to see that these instructions are carried out to the

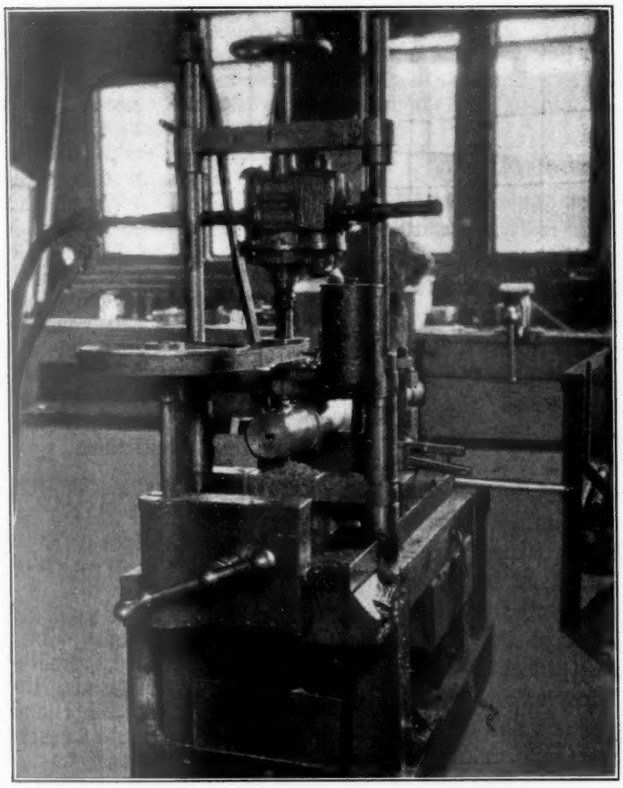
letter, along the same lines that they did when the Interstate Commerce Commission rules for the care and maintenance of locomotive boilers went into effect.

The most that the superheater company's inspectors can be expected to do is to report conditions as they find them. They certainly have not the time or the authority to investigate the causes of the infractions of the rules; neither do most of the engine house foremen have time with all their other duties to see that their instructions are carried out. In addition to this, the proper attention to the superheater sometimes prevents just what the engine house foreman is endeavoring to do—turn his locomotives in the least possible time. This he will do regardless of the superheater equipment unless there is a check placed upon him.

So, in these strenuous war times when everyone, even to householders, are endeavoring to save coal, we would urge the railroad managements to provide the necessary additional money to protect their investments and to carry out to a greater degree the purpose for which the superheater was designed.

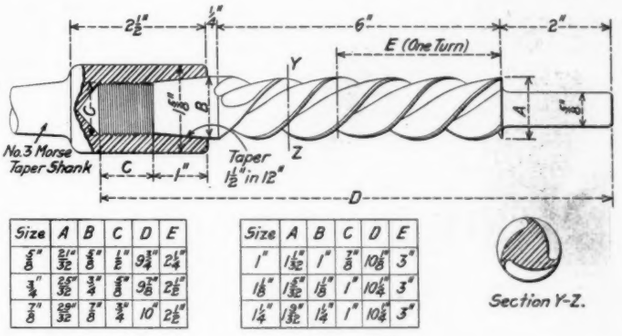
MACHINES FOR MILLING PISTON RODS KEYWAYS

It is the practice in many shops to use end mills for cutting the slots for crosshead keys in piston rods. Since such tools cannot take a heavy cut this method is rather slow. To secure better output on this work a helical milling cutter is used at the Topeka shops of the Atchison, Topeka & Santa Fe, and a special machine has also been developed recently which makes it possible to perform the entire operation at one setting.



Milling Slots for Crosshead Keys in Special Machine

The machine consists of a rigid base on which is mounted a standard for supporting the cutter and the air motor which drives it, and a carriage for feeding the work. The carriage, as shown in the drawing below, has a dovetailed slot to fit the table and two V-blocks for holding the rods. The standard consists of two vertical rods, securely braced, with two cross pieces at the bottom for supporting the cutter and another near the top fitted with a feed screw and hand wheel for supporting the air motor. The spindle for the cutter carries a pulley which is belted to a larger pulley on a vertical shaft, this shaft driving the feed screw through a worm and wheel.

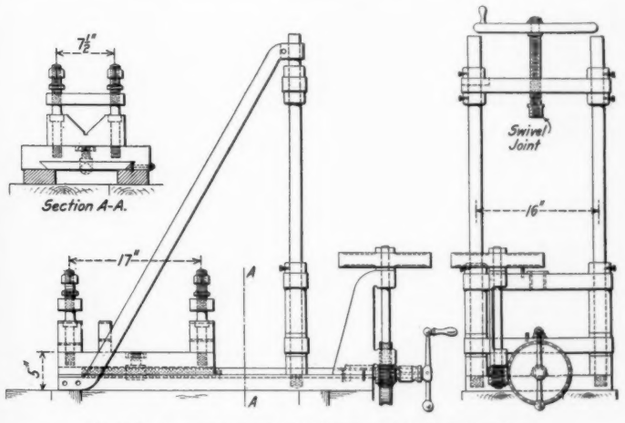


Size	A	B	C	D	E
⅝"	21/32"	⅝"	½"	9¾"	2½"
¾"	25/32"	¾"	⅝"	9⅞"	2½"
⅞"	29/32"	⅞"	¾"	10"	2½"

Size	A	B	C	D	E
1"	1 1/32"	1"	⅞"	10⅛"	3"
1⅛"	1 5/32"	1⅛"	1"	10¼"	3"
1¼"	1 9/32"	1¼"	1"	10⅜"	3"

Milling Cutter Used for Milling Piston Rod Keyways

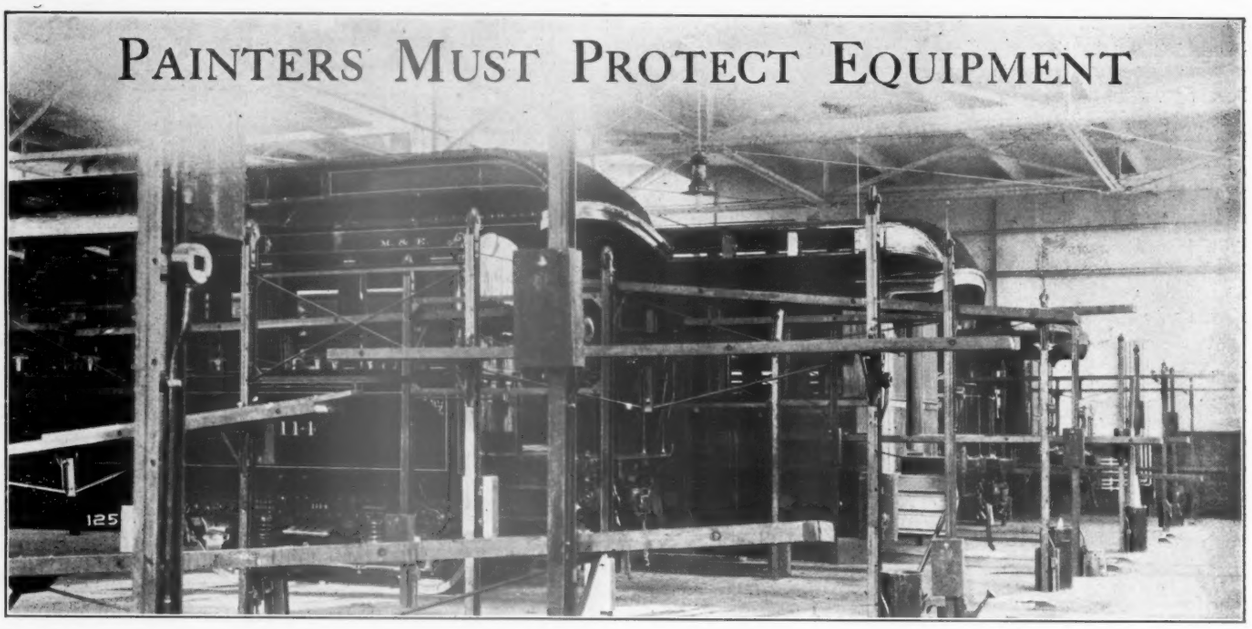
In operating the machine the piston rod is first clamped in the V-block and a drill of a size equal to the width of the keyway to be cut, is placed through the bearing in the cross seat, a bushing being provided to hold it central. The air motor is then attached and the hole is drilled through the rod at the end of the keyway. The bearings for the cutter must be in line with the centers of the V-blocks to insure that the keyway will be in the exact center of the rod. After the rod has been drilled a milling cutter is inserted in the hole, the pulley and spindle are put in place and the remainder of the keyway is milled out. A helical cutter of the type illustrated is essential for rapid work in the milling of these slots.



General Arrangement of Keyway Milling Machine

RAILROAD CONSCRIPT.—The New York Sun in a despatch from Oklahoma City tells of the first United States railroad conscript. Gibson Carson, a Grady county school teacher, who is of draft age, asked the local exemption board to be assigned to work which would aid the government and by which he could better support his wife and child, saying that he would be willing to fire a locomotive on the Frisco. Mr. Carson's plea was honored by the board, and he started in firing "Ole Betsey," claimed to be the crankiest locomotive on the Frisco at that point. The exemption board says it has authority to assign a draftee to this form of national service, as the railroads now are in charge of the government.

PAINTERS MUST PROTECT EQUIPMENT



THE PROBLEMS of the railway equipment painters are no less serious than those of other craftsmen in the mechanical department. Their duty is to protect the equipment and still keep it out of service as little time as possible. The following suggestions for conserving material, labor and time were received from prominent men in this particular field:

PRESERVATION—not appearance—is the watchword of the railway painter today. With a shortage of labor and materials and a material increase in the price of both, coupled with the extreme demand for the equipment in active service, the painter is "between the devil and the deep sea." He must, however, protect the cars and locomotives from rust and decay. He knows better than anyone else what the lack of proper protection means in the deterioration of the equipment and should not permit its being overlooked. His part in the maintenance of equipment, and particularly the steel equipment, is a most important one. With a shortage of labor and the lack of time, the past practices of painting will of necessity be changed. The various writers on this subject give suggestions as to what can be done. The use of enamel colors and paint sprayers are particularly mentioned as methods that save considerable time.

PAINT ONLY FOR PRESERVATION

BY J. D. WRIGHT
General Foreman Painter, Baltimore & Ohio, Baltimore, Md.

One of the biggest problems confronting the railway painters under present conditions is to get hold of the equipment to paint, as it is in such great demand. And when it is laid up for repairs on account of accident, unsafe condition, or being unfit for service for other reasons, it is hard to get sufficient time in which to paint it properly on account of the unusual demands. The equipment is wanted in service, paint or no paint.

The painting problems are insignificant when compared with the big problem confronting not only the railroad companies and their employees, but the entire country as well, —that of bringing the war to a successful conclusion. And we appear to have already almost reached the point when everything which does not contribute to this end will be considered a secondary matter.

With this in mind it seems reasonable to expect that the painting of railroad equipment will suffer, temporarily at least, while practically all our energies are directed towards winning the war. During this period, which we hope will be short, safety and movement of equipment are more essential than anything contributing only to their appearance, so it seems desirable to get down to the most practical methods of painting and do that which is absolutely necessary.

Under present conditions, the painting should be done mainly for preservation, especially on steel equipment, and as rapidly as consistent, with a view to keeping the cars and locomotives in service as much as possible whenever they are needed. This will conserve both labor and material and in this way contribute to the success of the railroads and also the country at large during these unusual times.

PROTECT EQUIPMENT BUT KEEP IT MOVING

BY J. E. ROSS
Master Painter, Gulf, Mobile & Northern, Mobile, Ala.

The three great problems confronting the master painter today are the almost prohibitive cost of materials, the scarcity of skilled labor and the need of equipment in service. In seeking means to adjust to and minimize these conditions, more than the ordinary amount of care and study should be given to the economical handling of all work coming under the jurisdiction of the painter, and close judgment with a leaning toward the radical should be exercised in determining the amount of work that should be done and arranging the work schedule, for here the foundation is laid on which depends whether the saving desired in material, time and effort is real or just imaginary.

A reduction of the amount of material used by cutting down the number of coats, thus saving both material and labor and giving a shorter shop schedule is to my mind the only means of solving the problems if equipment is to be shopped at all. Cutting the number of coats means a revision of shop standards, of methods and quality where the latter means an extra coat or an extra rub to further improve a surface already sufficiently good to clean and wipe down which is the real essential.

All exterior decoration should be discontinued by not redecorating or striping when necessary to cover up or remove old surface as must be done in extreme cases. The old surfaces should be patched with primer and putty. The removal of old paint by burning or by the use of solvents should be an extreme exception, as, beside the additional labor involved in either case, in the latter, potash and acetone are among the most needed war materials.

The master painter must remember that equipment must be kept moving and not allowed to deteriorate or depreciate for the need of minor repairs and protection from the elements. The maximum of service with a minimum of effort and material costs is the result required and which should be sought. Trade precedents and customs, trade rules and ethics must all give way to the new system during the present need.

CONSERVATION OF LABOR IN THE PAINT SHOP

BY J. H. PITARD
Master Painter, Mobile & Ohio, Whistler, Ala.

The shortage of labor has not seriously affected the paint department yet, due to the fact that in some cases the unusual demand for freight and passenger equipment has drained the shops of cars and thereby caused a scarcity of work. However, it is obvious that equipment, if held in service beyond the usual shopping period will require more extensive repairs when it returns. To the paint department, this means that more passenger cars must undergo the burning off process, which is the heaviest class of paint repairs, and of course requires the maximum of labor to handle it.

The problem of devising means for maintaining the painting of equipment in an unimpaired condition will cause much concern for every master painter. Many roads have previously adopted enamel colors in lieu of varnish for the exterior finish of passenger cars, and also to a limited extent for the interior, using enamel colors also for lettering and striping. By this method the two coats of flat color is eliminated, thus effecting a saving of several dollars on each car, and also effecting a saving of one or two days of the time that a car is usually detained in the shop. This method produces fairly good results when the highest grade enamels are used, and for those shops that are still using the flat color and varnish method, it doubtless offers to some extent a solution of the labor shortage problem when that time arrives.

This method also applies in the painting of locomotives. When the surfacing is completed and the job is ready for the color coats, a space large enough to receive the lettering is painted with flat color, and the lettering is applied and when dry the letters and entire space is varnished, and then the remaining surface is coated with varnish color. This method expedites the work, and if handled properly, makes a satisfactory job. The methods mentioned above have been found quite satisfactory in short cutting the work and also in reducing the cost. But so far as the finished appearance of the work is concerned, it does not quite compare with the flat color and varnish method.

In painting freight equipment, the solution of the problem of labor shortage is the paint sprayer. With a good sprayer, an operator and a helper should paint from 15 to 20 cars per day of eight hours. The sprayer consists of a portable tank holding about 30 gallons, a single hose, 60 feet long, to the end of which is attached a seven foot ¾-in. pipe with a nozzle and cut off valve. With this outfit, the largest car can be coated in from 15 to 20 minutes.

POSSIBILITIES FOR REDUCING PAINTING COSTS

BY B. E. MILLER
Master Painter, Delaware, Lackawanna & Western, Kingsland, N. J.

The following are my views as to possible curtailment in the expense of painting cars and locomotives:

Passenger Cars.—A reasonable amount of surfacing or smoothing-up should be done on passenger cars as otherwise cleaning and wiping cannot be carried on successfully. Where appearances are to be disregarded entirely, but little money need be spent for puttying and levelling up uneven or defective parts.

Most railroads have already dispensed with all striping and decorations on the exterior of passenger cars. On a number of railroads the use of varnish on exteriors of passenger cars has been discontinued and varnish colors or so-called enamels are being applied. This means a considerable saving as to both time and material. The surface produced is not equal in appearance and lustre to one which has been varnished, but is a fair substitute. It may be cleaned up acceptably at terminals and wearing properties are about equal to a varnished job.

Little may be expected in the way of additional economy on interiors of passenger cars. Most of these are now finished in natural wood or grained to imitate the wood and in some instances the surfaces are enameled, suitable combinations of colors being employed. It is quite unlikely that the discriminating taste of the public would for a while at least be disregarded by substituting something inferior and less pleasing. Sanitary conditions, too, have to be reckoned with and cleaning must be made comparatively easy and economical. Plain painting with oil colors could, of course, be substituted for the varnished or enameled finish should such a step in the direction of economy become unavoidable; for sanitary reasons, however, we would consider this impractical.

Locomotives.—On most railroads, it would appear, that the limit of plainness and economy has about been reached in painting locomotives. Striping and other gold-leaf ornamentations have been discontinued, the Lackawanna having received orders to that effect only a few weeks ago. The use of varnish may be dispensed with and replaced by varnish colors or locomotive finish black. On a great many roads this has already been done for a number of years. Cheaper materials such as are used on freight cars cannot very well be substituted as these cannot be cleaned and wiped successfully.

Freight Cars.—Very little may be said in the way of recommending a less expensive method to be followed, as the cheapest labor and the most economical materials are, generally speaking, employed for freight car painting. The use of special colors—reds, greens, etc., on special service cars, such as cabooses, refrigerators, line cars, etc., may be discontinued and ordinary freight car paint applied. The use of badges, trade-marks or other stenciling on freight cars, of a purely advertising nature, might be dispensed with if deemed advisable. Except for appearances as to wooden cars and the necessity of protecting steel equipment against corrosion, the painting of freight cars might be discontinued entirely for a period of time if appearances may be disregarded. All stenciling and necessary marking would naturally always have to be applied.

The conservation of labor in the paint department must be accomplished by the substitution of cheaper methods and the discontinuance of unnecessary operations or those not absolutely essential to safety. Among the latter may be classed the cleaning of cars, exterior and interior, or such portions thereof as will not conflict with sanitary regulations

and endanger the health of patrons, as well as the cleaning of locomotives.

Many paint shop operations could be taken care of by women and eventually it may become necessary to make use of them where practical.

CUTTING DOWN THE PAINTING EXPENSE

BY CHARLES E. COPP
Foreman Painter, Boston & Maine, Billerica, Mass.

The high cost of living has hit everybody and has found in the railroads a shining mark, and the end evidently is not yet. We must all say and *do* all we can to help the struggling roads over and through this hard epoch in their history.

The painting departments of most roads, and the Master Car and Locomotive Painters' Association in particular, has done its part toward the reduction of the cost of painting cars and locomotives. In 1875, Robert McKeon, secretary of the above association at that time, said: "A first-class day railway coach on any of our main roads costs, when complete, about $6,000. To protect this work the painter expends from $300 to $600. Twelve weeks should be the time allowed to paint a car." Mr. McKeon gave some good advice here, but if he had lived to see this day in some, if not most of our shops, he would have seen the time required to paint a passenger coach cut down seventy-five per cent below those figures, if not more, and *still going down!* And still the cost of the railway coach has greatly increased over those figures. However, I am not here citing the increased cost of the building of the car of today as any reason why we may not look for ways to even further reduce the cost of finishing them in the paint shop, if possible, and I have little doubt but that this can be done without serious detriment to the equipment of some roads.

Whatever is plain, whether inside or out, can be repainted and varnished oftener and, therefore, the general appearance is much better. Some roads are still without justifiable reason painting their car exteriors with all the striping, etc., just as they did 30 or 40 years ago. Material is constantly being piled up on cars that can be reduced in quantity by reducing coatings that can be abolished. Passenger car floors are being loaded down with two coats or more of paint annually, which is worn off only in the aisles and between the seats, when one coat of flat-drying material, to give an even appearance to the floor, and sweeten up its sanitary condition to start it off in service, is all that is needed. The floor that will not wear off quickly is one made of cement with a trowel, instead of paint with a brush. Half as much or less interior varnishing as some are doing will load up the finish less with grime and material to crack. Rubbing up after washing with a suitable non-drying renovator oil is enough for many cars that have been varnished the previous year or two.

Less gold-leaf and more gold-colored paint letters should be used. The Boston & Maine made the latter the standard years ago for all baggage, mail, milk and express cars and is extending its use largely on second-class passenger carrying cars. Much needless sandpapering can be omitted on luggage carrying cars without detriment to equipment. One coat of body color and one coat of varnish can be dispensed with on all painted cars by uniting the second coat of color and the first coat of varnish in a durable body enamel for all cars where the paint letters are to be applied. This has been practiced by the Boston & Maine with good results for several years.

Probably much car washing can be omitted by painting some "storage" equipment little used without washing, including inside of baggage and similar cars that are in suitable condition. And doubtless many other ways can be devised to save labor and material, but each road with its own peculiar service and needs has to be its own judge in these matters, and if they will look around sharply with the disposition to save if they can, they will find plenty of opportunities.

INTELLIGENT BUYING AND INTELLIGENT SUPERVISION

BY J. W. GIBBONS
Atchison, Topeka & Santa Fe, Topeka, Kan.

It is a well known fact that on very few railroads are the foremen painters consulted upon the purchase of materials used to protect the equipment. In other words, he is held responsible for results without a chance to demonstrate his ability to give results. If he is brave enough to suggest a certain grade of material, which he knows by experience would give satisfactory service, he is very liable to be suspected of having ulterior motives. The result has been that men higher up, who knew nothing about paint materials, have had control in the choice of materials, and have been easily imposed upon.

The unscrupulous manufacturer has been enabled to sell his worse than worthless materials to the railroads, because the only man who could check him up was afraid to do so. Is a painter less reliable than a machinist, a carpenter, or a clerk? Would anyone employ an editor or a lawyer to perform an operation for appendicitis?

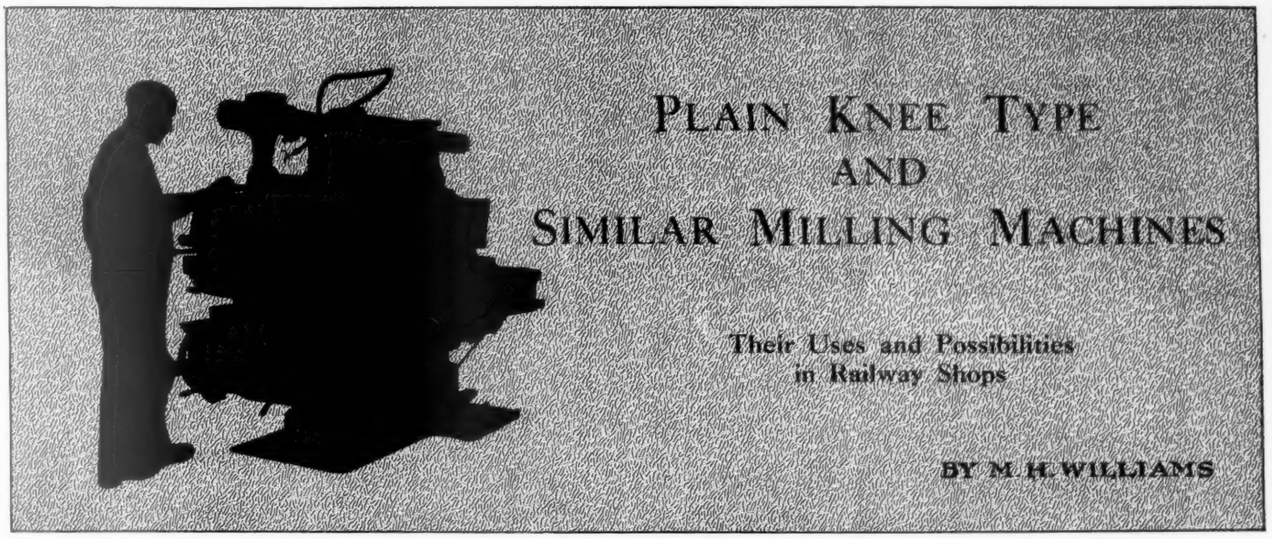
Every man who has studied the question knows that improper cleaning of cars and locomotives has destroyed more paint and varnish than all other agencies combined. Now, that the very life of our country is at stake, are we going to continue in the same old rut and make the same old blunders?

I know that thousands of dollars can be saved in the painting and cleaning of cars and locomotives, and at the same time the general appearance of this class of equipment will be greatly improved if the work of painting and cleaning of paint and varnish of each railroad be placed under the supervision of a man who understands not only the proper methods to use in applying paint and varnish, but who also knows something of the nature of the materials of which they are composed, and the best methods of preserving them.

Books of Rules, outlining methods to be used, are good things, but unless followed up by a competent supervisor, very little attention is given them, and high grade cleaning materials are often worse than wasted because they were not properly handled.

The primary object in painting cars and locomotives is to protect them from rust and decay. In selecting paints to protect railroad equipment, the nature of the material to be painted and the service it is expected to render should be considered, and it should be thoroughly impressed upon the minds of the purchasing powers, that the substitution of cheap oils and pigments is wilful waste of both labor and material. The constant demand for man power is very apt to bring into vogue practices that have heretofore been considered too wasteful of material to warrant their general use on cars or locomotives. I speak now more particularly of devices to spray paint or varnish. It is an acknowledged fact that with a spray it requires from five to twenty per cent more material to secure the same thickness of paint film that can be obtained with the brush. It should also be borne in mind that, in the light of the information furnished by the Government itself, as to the injurious effects of the mist and fumes which arise from the materials when sprayed, their use would be unpatriotic, if not criminal, unless the shop was equipped to protect the operator from the poison vapors.

Intelligent supervision of the paint department, which should include the cleaning of equipment as well as the painting of it, can and will save thousands of dollars.



Plain Knee Type and Similar Milling Machines

Their Uses and Possibilities in Railway Shops

BY M. H. WILLIAMS

SHOPS manufacturing machine tools, automobiles and various appliances for the market are going more and more into the use of milling machines. These machines are to some extent taking the place of planers, slotters and shapers. This change has been brought about by the increased economy and high grade of work possible with modern milling machines, and especially those of the knee type.

In machining locomotive parts such as rod keys, wedges and brasses, pedestal shoes and articles of a similar nature, the knee type of milling machine will prove a very economical machine tool, experience having shown that parts like those mentioned above can be made much quicker on the milling machine than on any other. There is, however, a limit for milling, and for light running repairs where only one piece is to be machined at a time, the milling machine cannot be recommended. The universal type of milling machine is now quite extensively employed in railway tool rooms and has proved very satisfactory for the smaller work. But as a rule it does not have sufficient strength and pulling power to quickly mill locomotive parts, where it is a question of removing metal at a rapid rate.

For the economical manufacture of locomotive and car parts, the largest types of plain milling machines will be found none too large for the first installation. As the work grows, smaller machines can often be used to good advantage in conjunction with the larger ones. With these larger knee type machines, a number of milling jobs now done on the planer type slab miller, can be finished very much quicker on account of greater ease of manipulation. This will relieve the more costly slab millers and in turn allow the planers to be employed on other work.

IMPROVEMENTS IN MILLING MACHINES

In the last few years a number of improvements have been made in the plain milling machine that have added to its adaptability for railway work, and the two more important of these are, greater power to drive cutters to the limit and quicker methods for changing speeds and feed, so that either can be readily adjusted for any particular article to be machined. This second improvement is especially valuable in railway work where a long run on one job cannot be expected on account of the comparatively few parts to be made at one time. The later machines are provided with necessary pumps for supplying a liberal amount of cooling compound, which insures keeping cutters and work cool and adds very materially to the life of the cutters and the speed of production. The above and other improvements put the plain milling machine in a class that should receive careful consideration for future installations of machine tool equipment.

Cutting Speeds and Feeds.—With the slow speeds common on milling machines a few years ago, the time required to finish a given surface did not compare very favorably with the planer, but with the speeds now available, the milling machine has outclassed the planer for a large number of jobs. Present cutting speeds and feeds would have been considered out of the question a few years ago.

The following are illustrations of what has been done and what can be duplicated or exceeded in any railway shop having proper machines, cutters and methods:—the flat surfaces of rod keys made from .40 per cent carbon steel, 1 in. to 1½ in. wide, can be milled at cutting speeds of 40 ft. to 80 ft. per minute and feeds of 3 in. to 6 in. per minute; the rounded corners of rod keys are cut at feeds of 3 in. to 5 in. per minute, using concave cutters of suitable radius; flat surfaces like driving box wedges 6 in. wide, are cut about 3/16 in. deep at feeds of 2½ in. to 5 in. per minute; the flat surfaces of a rod key 12 in. long are milled in two to three minutes actual cutting time. This should be compared with the time required to finish similar articles on a planer or shaper on which these parts are now mostly finished.

With the speeds and feeds as mentioned above, it will be necessary to grind the cutter one or two times a day, the time required depending very largely on the amount of slag or seams in the steel or wrought iron being milled. Iron castings can generally be milled at greater speed than mentioned above but much will depend on the hardness of the iron and the smoothness of the surface demanded. Steel castings can be milled at about the same speed as low carbon steel forgings. However, the amount of sand burned into the casting will largely limit the speeds and life of the cutters.

Holding on Machine.—High speed milling makes it necessary to very securely hold the article to be milled, but the vise furnished as part of the machine is usually strong enough. The question of special holding fixtures would have to be worked out to suit local conditions, which would be governed largely by the number of articles to be made at one time. Articles to be machined can be clamped on the milling machine as quickly as on the planer or slotter,

and ordinarily the cost of holding fixtures for either class of tool would be about the same.

MILLING CUTTER IMPROVEMENTS

The improvements in milling cutters adapted for railway and other work have been quite remarkable in the last few years and have contributed greatly to the present success of milling. A description of what is now the most desirable cutter as compared with the older forms will be of interest, especially to those who have not given this question careful consideration.

The cutters of a few years ago had teeth spaced from ¼ to ⅜ in. and many are in use today, the faces of the teeth being cut radial from the center. The teeth were generally cut straight or only slightly spiral and except on form cutters or gear cutters they were rarely ground on the cutting face. The belief was prevalent that fine teeth were necessary in order to obtain smooth surfaces but later investigations have shown, and it can be proved by an examination of milled surfaces, that there will be one depression

Fig. 1.

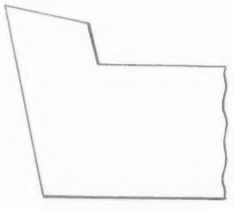


Fig. 2.

for each revolution of the cutter. If feeding 1/16 in. per revolution of cutter, the depressions will be 1/16 in. apart; ⅛ in. feed, ⅛ in. apart, etc., this showing that depressions are revolution marks and have no reference to the number of teeth in the cutter. Or in other words, a cutter of one tooth, 10 teeth or 40 teeth will cut practically to the same degree of smoothness when employing the same number of revolutions per minute and feeds, and worked within practical limits of milling.

The cutter now largely employed for flat surface milling, and which can be obtained from a number of concerns, has teeth spaced from 1 in. to 1¼ in. and cut on a spiral of about 25 deg., the face of the tooth being undercut or given a rake of from 7 to 10 deg., the cutting face and top of the teeth being ground after hardening. All sharp corners at the bottom of the tool are avoided. The above mentioned features are worthy of careful study, the object aimed at having been to design a cutter that will produce a satisfactory finish and have the maximum strength to cut and remove metal quickly with the least consumption of power.

In many respects what has been found to be good practice with lathe tools has been followed in the design of cutter teeth. Generally speaking, a milling cutter may be likened to a number of lathe tools clamped in a circular holder and revolved. As a matter of fact some of the larger slabbing face mills are made up of a number of tools similar to lathe tools set and clamped into recesses in steel disks.

Let us compare the tooth of a modern milling cutter and a lathe tool.

Fig. 1 shows the form of tooth of a modern milling cutter and Fig. 2 shows a lathe tool ground according to modern practice for light cutting of wrought iron or steel. The similarity of the two is at once apparent. Note that the cutting face of the cutter tooth shows about 10 deg. rake, in order to properly curl or clear the chip, and follows lathe practice. The form of tooth is designed for strength and all sharp fillets are avoided to reduce the possibility of cracks when hardening. The face of the tooth is ground after hardening to remove the chip without friction and for the same reason that the top of a lathe tool is ground. It would be considered very poor practice not to grind the top face of a lathe tool after hardening and the same applies to milling cutters. The question of grinding will be considered later. The spiral form of cutter, as well understood, has many advantages and it is a question just how great the spiral should be. Twenty-five degrees appears to be a happy medium. The effect of this spiral is that chips are peeled from end to end, and on wide surfaces two or more teeth are cutting at one time, and as a result the cutting is continuous. This reduces the chatter of the cutter and the hammering of the gears of the machine. Objection has been raised to this high degree of spiral on account of end thrust on machine spindle, but with reasonable limits, say 25 deg., the end thrust will not seriously affect the power consumption or wear of the machine.

Experience has shown that the coarse tooth cutters will mill a greater number of similar articles between grinding than the older form and admit of doing the work much quicker. This is accounted for largely by the design of the tooth, which peels off the metal in the form of a good husky chip in place of chips resembling iron filings, as generally follow with old cutters and methods. Compare the thickness of chip of two cutters of the same diameter, one having 10 teeth and one 40 teeth, and feeding, say 1/16 in. per revolution. Theoretically the 10-tooth cutter will remove chips .006 in. thick and the 40-tooth cutter one-fourth as thick, or .0015 in., the latter only amounting to a scrape. In actual practice when feeding this small amount per tooth, several teeth will glide over the work without cutting and the theory is advanced, which appears to be borne out in practice, that the teeth of cutters are dulled fully as much in glazing over the work as in cutting a reasonably large chip. Also the horsepower hours required to remove metal will be much greater where light chips are taken. Referring to Fig. 1, attention is called to the fact that the form of tooth has been designed for great strength, the removal of heavy chips and to withstand an accidental "hook in" to the metal being milled.

From all data available these coarse tooth, 25-deg. spiral, undercut, ground face cutters will remove the same amount of metal as the older form, with 25 per cent less power, and when properly used with a large supply of cooling compound, milling is now done at from two to six times the old rate.

Diameter of Slabbing Cutters.—Small diameter cutters are generally recommended for the average railway work

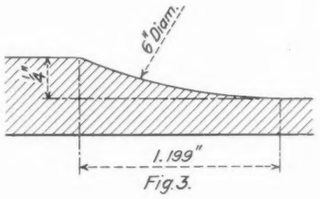


Fig. 3.

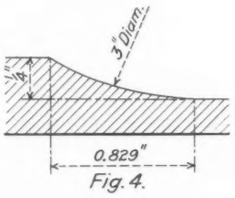


Fig. 4.

as they have little drag on the milled surface, that is, they will remove a short chip. Too small a cutter, however, limits the size of the arbor and a happy medium must be struck. Figs. 3 and 4 show graphically a cut ¼ in. deep taken by two cutters 6 in. and 3 in. in diameter. The 3-in. cutter will be in contact .829 in. and the 6-in. cutter 1.199 in., or approximately 14 per cent longer. As a result, the larger cutter takes a longer chip than the smaller one, which is objectionable on account of extra wear on the cutting edges. The inserted tooth cutter cannot well be made small and have the necessary strength of body to properly support the blades, and while they are cheaper at the present abnormal

price of high speed steel, they cannot be recommended where the smaller solid cutter can be used; this applying particularly to plain flat surface milling.

The nature of the work must naturally govern the cutter diameter and no hard and fast rule can be laid down to govern all cases. As a general proposition, however, for the facing of articles as mentioned above, cutters 4½ in. in diameter, with a 2-in. arbor hole answer the requirements very well. With a 2-in. arbor, the use of the arbor supports, supplied as part of the machine, will prevent objectionable chatter under heavy cuts, but this size of cutter will admit of only about two redressings which makes an expensive cutter at the present price of high speed steel. However, it will be found cheaper than carbon cutters per 100 pieces milled, to say nothing of the saving on account of higher speeds. Solid cutters of 4½ in. diameter, 3 in. to 6 in. long, with a 2-in. hole are very useful tools on these machines. Where cutters must be larger than 4½ in. the inserted tooth is generally used. For heavy and fast

Fig. 5.

milling the blades should not be less than ½ in. thick and they should have all the spiral the design will permit. Many an inserted tooth cutter has failed on account of too thin blades that would not stand the strain and carry away the heat from the cutting edge. The objections to inserted tooth cutters are the difficulty of obtaining sufficient spiral, lack of chip space and liability of breaking the teeth.

Face Mills.—For railway work face mills are useful and work equally well if made solid or with inserted teeth, the latter being generally used except in the smaller diameters on account of lower cost. In face milling, practically all the cutting is done by the periphery of the cutter, as is the case with a slab mill. Therefore, the teeth should have the same degree of rake and angle as the slab mill. For rapid cutting, the blades must be thick and heavy to stand the strain of heavy cutting. At least ½-in. blades are desirable and several good makes of cutters suitable for railway work are now on the market. Face mills are useful for milling driving box cellars and a number of castings used on the locomotive and tender, as well as steel passenger car parts requiring finish.

Formed Cutters.—For certain work, such as the rounded edges of rod keys, concave cutters can be used to good advantage and these may be purchased with practically any radius demanded, and can be ground without change of contour. The time required to mill a rounded corner or a half round is very much less than planing with a concave planer tool and also the surface will be much more accurate. A good illustration of the possibilities of form milling can be found in the transmission gear shafts of automobiles, where the shafts are milled to fit the broached holes in sliding gears. This calls for a class of milling nearly perfect and is probably a better grade of work than demanded for locomotive or car construction, or repairs.

GRADE OF FINISH

Locomotive and car parts coming within the range of the machines in question rarely require a "dead" smooth finish and generally where the machines and cutters are kept in good condition, the work as it leaves the machine is smooth enough to meet all the requirements without additional work except the removal of burrs.

Where milling at a rapid rate of feed, say six inches per minute or more, the surface will show decided revolution marks resembling humps and hollows that may appear a great objection at first glance. Figuring shows that with a 4-in. cutter and feed of ⅛ in. per revolution, the hollows will be .00097 in. deep; and with 1/16-in. feed, the hollows will be .00024 in. deep, or an amount so small that it cannot readily be measured on a flat surface. It would be difficult to find a place on a locomotive or car where a surface as smooth as this would not meet the requirements, as far as wear or fitting are concerned. Should a very smooth finish be demanded, such as the surfaces of rod keys bearing on wedges, either of two methods can be followed. One is to speed up the cutter to possibly 60 ft. cutting speed and feed at a rate that will produce a satisfactory finish, say at three inches per minute. The other method is to take a rough and a finishing cut; the rough cut at 40-ft. to 60-ft. cutting speed and feeds of 6 in. to 10 in. per minute, and afterwards a finishing cut at the same setting by raising the machine table from .005 to .010 inch, the finishing cut being made at the same cutting speeds, but slower feeds. The first method is quicker and generally satisfactory where the article to be milled can be clamped to prevent springing. For a frail article that is liable to spring under a heavy cut, the second method will produce more accurate results.

Face milling with well ground cutters will present a smoother surface than slab milling. However, a face mill requires more time to take a cut as the cutter must feed the length of the piece plus the diameter of the cutter. Unless cutters are very carefully ground, one or two teeth are liable to project more than others and produce a rough finish; also, the milling machine must be in a good state of repair and the spindle at exact right angles to the ways to prevent cutting hollow.

MILLING LOCOMOTIVE PARTS

A brief description of methods of milling a few locomotive parts may be of interest.

Piston Valve Bushings—Ports.—These ports can be very quickly machined on the plain knee type milling machine, and for this work the so-called end mill is used. It should preferably be spiral with but few teeth and of a diameter as large as the design of the port opening will admit. For holding the bushing, a rotary table that can be obtained with the milling machine can be used to good advantage and it is desirable to provide a disk of boiler steel about ½ in. thick and accurately center it on the table. This disk should fit the bore at the end of the bushing which will center the bushing on the table, the bushing to be held down by clamp bolts inside. The revolving table should be rigid as with some designs of valve bushings the port holes will be some distance from the table, which will put considerable strain on the same when taking heavy cuts at a rapid rate. The port holes should be marked on the bushings and the machine operator can then revolve the table and raise or lower it to follow the lines marked on the bushing. With proper appliances, the admission ports in bushings, cast from moderately soft cast iron, can be milled in one hour and insure accuracy to a few thousandths of an inch in width. High speed steel mills should be used for this purpose.

Link Motion Levers.—These are milled in a very satisfactory manner and in much less time than is possible by slotting or planing. There are so many designs that no hard and fast rule can be given to meet all conditions; also, for plain milling machines the length is limited to cuts of about 45 in. One method of milling is to first mill the flat sides at the ends of the levers, this being done when holding the levers in a vise supplied with machine. For the longer levers two vises are employed and plain slab milling cutters are used for the purpose. With a good grade of forgings the milling can be taken at cutting speeds of 40 to 80 ft. per minute and feeds of 3 in. to 6 in. per

minute and produce a finish generally meeting all requirements; this being a job where the ability to hold the piece on the machine, rather than the cutter capacity, governs the speed of milling. The flat milled surface is very desirable for drilling the holes for motion pins and also where the design admits, a large hole can be drilled at the bottom of the jaw and the metal up to the hole cut away with a cold saw. It is best to operate two saw blades at one time, properly spaced to cut out the entire block at one travel of the saw. Where cold saws are not available, these blocks may be removed by sawing on the milling machine. This requires a large saw, probably 10 in. to 12 in. diameter, and a saw of this diameter cannot well be driven by the usual method of collars and key or spline, on account of shearing the latter. One method followed to overcome this difficulty is to order saws having four holes drilled in them, about 2 in. radius and make a pair of collars properly drilled to register with holes in the saw, and bolt through the saw and collars, a keyway being cut in the collars and saw. This will allow ample driving power.

For the remaining milling it is desirable to make a holding or milling fixture and a simple design for this purpose can be made from steel about 1½ in. thick and about 6 in. longer than the piece to be milled and 1 in. or 2 in. wider than the lever. This bar is milled to fit grooves in the milling machine table and pins should be located in the fixture, spaced exactly the same as the holes in the lever to be milled. When milling, the lever is to be clamped onto this fixture by the usual method followed on planer work.

A fixture of this nature has advantages over holding in a vise, as the piece can be held more securely and avoids possibility of shifting when milling. Also, as the lever will be located in exact reference to the table, the throw-off stops for the milling machine table can be properly set to mill each piece alike. This is an advantage when milling to a fillet. By a careful setting of the machine, any number of parts can be milled without the necessity of laying off, as is generally the practice where the articles are machined on planers or slotters.

For milling the inside of jaws it is customary to employ a cutter about ¼ in. smaller in diameter than the opening and this cutter should preferably have an outer support in the arm support supplied with the machine. This can be arranged for by making the outer end of the cutter of a diameter about equal to the bottom of the teeth, or to the nearest standard size of arm brace bushing. Fig. 5 illustrates the cutter.

It is generally desirable to mill on the bottom jaw and turn over for milling the opposite side. By this method the cutter can be fed to the large hole drilled at the bottom of the jaw. Conditions arise where this cannot be done on account of the holes in each side of the jaw not being alike and where the jaw must be milled from one setting. In this event, after milling the lower surface, the table can be lowered for milling the upper jaw. To mill the upper jaw it will be necessary to clamp the upper jaw to prevent it from springing. Surfaces other than the round ends are very readily milled on the fixture mentioned. The rounded ends of these levers cannot well be milled on the plain horizontal milling machine without the use of a vertical milling attachment and circular table and if large vertical milling machines are available, they should be used. The levers can readily be held by a center bolt secured to the revolving table.

When milling these levers it is very essential that the operator make use of the micrometer dials on the table, especially when facing the surfaces between the ends where it is necessary to raise the table to a predetermined distance, in order to obtain the correct thickness of the lever. Where this is insisted on, the operators soon become accustomed to making several different cuts on one piece without measuring with a rule or calipers.

It would be difficult to give an exact comparison of time for milling as compared with slotting or planing, as much depends on the design of the lever and the operators. The time for setting up should be about the same for either operation. Milling should eliminate laying out the lever, where advantage is taken of the table stops and micrometer dials. The finish by milling will be generally smoother than slotting, and unless a high polish is demanded, the pieces can be milled smooth enough for use without other finish than removing burrs. The time of actual milling should not average over 50 per cent of the slotting time, so that the milling should result in considerable economy.

Driving Box Shoes and Wedges.—If a dead smooth finish is not considered essential the milling cuts on driving box shoes and wedges can be taken at the fastest speed the cutter will stand. With fairly good forgings and removing not over ¼ inch depth of cut, a cutter speed of 60 ft. per minute and feeds of 3 in. to 6 in. per minute can be obtained, the rate of feed being largely governed by ability to hold the wedge on the holding fixture. It should be borne in mind that the thrust from the milling cutters on the wedge is quite heavy as from 15 to 20 hp. will be consumed when milling to the limit of modern cutters on a surface of this kind. All the thrust of the cutter must be taken up by the wedge, and unless the piece is well secured, it is liable to shift or slip and damage the cutter.

On account of the taper generally given these wedges, it is advisable to make a holding fixture for the milling. This can be made cheaply from cast iron or a forging of the same width and 2 in. or 3 in. longer than the wedge, the extra length being necessary for bolt holes for clamping. This block should be about 2 in. thick at one end and tapered like the wedge and it is advisable to place a tongue or spline in the bottom surface to fit grooves in the machine table. A substantial stop should be bolted to the thicker end of this block to take up the thrust when milling. For holding the wedge on the block, the customary planer practice of pointed screws pointing slightly downward, or pointed pins pressed onto the wedge from cup pointed screws answers very well. The customary form of blocks used for the screws can be held from grooves in the table, as in planer practice. The thick end of the wedge should point towards the cutter.

When setting up a long piece of this nature it is often necessary to drive thin wedges under the high places which will prevent the piece from springing. This applies especially on the first side milled and the second side can be milled without wedges. One cut over each of the flat surfaces will produce a smooth surface that should meet all requirements. The sides of the wedges can be milled two or four at a time when held in the milling machine vises, the wedges being turned end for end for parallel holding. The rounded corners can be milled with concave cutters and it is advisable to use two and space them so as to mill both sides at one time. For this operation the wedge is held on the holding down block. The ends of the wedges can be readily machined by face mills while holding the wedge in the machine vise. The actual time of milling would be approximately as follows for wedges 18 in. long:

2 Flat surfaces, 4-in. feed per min	9.00 min.
2 Edged (two milled at a time), 6-in. feed per min	3.00 min.
Rounding corners, 8-in. feed per min	2.25 min.
Ends (assuming 8-in. wide wedge), 4-in. feed per min	4.00 min.
Total	18.25 min.

To this must be added the time required for cutters to enter and leave work. However, 20 min. can be considered a fair approximation of the total time required and the speed of milling quoted above can be lived up to in every day practice. Some milling machine makers will advocate

greater speeds, but too great a speed can only be obtained by sacrificing the life between grinding of cutters. The time required to set up work was not considered in the above result because it should be about the same for millers or planers but any fair trial will prove the superiority of the former.

Driving Box Cellars.—Where the design calls for finished surfaces next to the driving box they can be milled to good advantage on the knee type of machine and a very satisfactory method is to clamp to the table as many cellars as the travel of table will admit, the surface to be milled being set to extend over the side of the table about ½ in. This method of setting admits of using face mills which are preferable to slab mills on frail surfaces like these cellars. The diameter of the face mill will be governed largely by the width of the surface to be machined, too large a mill being difficult to grind and insure each tooth cutting an equal amount. Ten in. mills for this and general work appear to be a good compromise. Should the surface to be milled exceed the limit of the 10-in. cutter it is advisable after taking one cut to raise or lower the table for a second cut rather than use too large a cutter. Cast iron cellars should be milled dry, or possibly the surface washed with kerosene oil to prevent dust, but steel cellars should be milled using a cutting compound.

Steel Castings.—On account of the surfaces of steel castings being full of sand and grit, they do not at first glance look promising for milling, but as a matter of fact, they can very readily be milled with only average grinding of the cutters. Where possible the use of the face mill is preferable on account of cutting under the scale. It is very important that the cutters be flooded with cooling compound, both to keep them cool and to wash away the sand that is loosened by the mill. The speed of milling steel castings can be about the same as for carbon steel forgings.

Rod Brasses.—With proper care rod brasses can be milled to fit the jaws of main rods without other fitting or filing than that of removing burrs. While very careful attention to measurements and fixtures is necessary, the work can be performed by workmen not having any great amount of experience in shop work or on milling machines. The varying sizes of rod jaws makes it necessary to fit practically each set of brass to a particular rod, which in turn necessitates measuring each rod separately and fitting each brass individually. A very satisfactory method of handling this work is to make a revolving holder for the brasses with four point index plate divided very accurately for insuring the sides of the brasses being square, the distance between the flanges being taken care of by raising or lowering the table. End shell mills of about 3 in. diameter are well adapted for this purpose.

A very satisfactory method for fitting these brasses without filing is to measure each rod, preferably with micrometer calipers, and also measure the various surfaces of the brasses as each surface is milled and adjusted, to obtain the required sizes. That is, if the first or trial cut shows say .015 in. over size, the table can be adjusted that amount as indicated by micrometer dials on the different table adjusting screws, and a second cut taken. This method is not difficult after a little practice and, of course, requires care on the part of the operator, but no great skill. Fitting rod brasses by any method requires care and where milled, the surface will be more accurate than the average filing, and in shops where a number of rods are fitted, the milling process will be found the more accurate and economical.

COOLING COMPOUND

The value of having an ample supply of cooling compound flowing over the tool to properly carry away the heat generated by the cutter is hard to estimate, and without it the present high speed of milling would not be possible. Looking backwards at old practices with milling and other machines makes one wonder why we didn't flood the cutters at an earlier date. For years it had been the practice to flood the chasers of bolt cutters and taps in nut tapping machines and we all knew the value of the same. Probably the fact that the old style milling machine was equipped with a can from which some 10 to 40 drops of oil per minute could be fed to the cutter prevented experiments of flooding cutters.

With the advent of high speed steel cutters and the increase of speeds it was found that the limit of speeds was reached when the chips removed showed the effect of heat by discoloration, this being an indication of dull cutting edges. Flooding the cutters with cooling compound has the effect of cooling each cutting edge of the cutter after taking a chip so that when coming into play again the edge is cool, and the work is also kept cool. An article milled at high speed and also the chips show no indication of heat when handled directly after milling with a flooded cutter, but if the cooling compound is shut off the chips will discolor at once.

Many old milling machines of the planer type used largely on rod work, also the upright type and the tool room millers as well as the plain knee type, have been speeded up above their original rate of milling as a result of the application of a more liberal supply of cooling compound. This has generally required larger pumps and piping and where used has at times resulted in overflowing the tables, making it necessary to increase the passages from table to tank and to place extra guards around the table to prevent flooding the floor. However, where the machines have been equipped for greater supply of cooling compound, the results have well justified the cost on account of a greater output from the machines. It is cheaper to speed up machines than to buy new ones.

It is not advisable to direct the compound on the cutter with great force on account of sparking, but it is desirable to have a large stream at low pressure and for the average machine, pumps to supply 10 to 15 gallons per minute, answer very well.

Several forms of nozzles are used and for plain slab milling, some prefer a sheet metal or cast hood, covering about half the top of the cutter, the cutting compound being fed to the top of the hood. This floods the cutter in a very satisfactory manner and is also to a certain extent a safety measure. For some work a flattened nozzle about the same width as the cutter is long is used, delivering compound as near as possible to the point of cutting.

For face mills a pipe directed onto the face of mill near the entering side of the cutter answers very well. Where milling jaws like the ends of link motion rods, the compound can be directed into the jaws and onto the cutter by two pipes bent like the letter C. For vertical mills such as used on side rod ends a plain pipe pointing towards the point of contact of cutter and work is used. Experience will soon dictate satisfactory forms of nozzles for various kinds of milling.

Most any good cutting compound answers fully as well as oil, the object of the compound being to conduct the heat away from the cutters. Oil cannot be recommended on account of excessive cost. Cooling compound is of no value for ordinary brass castings or cast iron.

The output of most old style milling machines can be about doubled by following the plan of keeping the cutters cool as outlined above and this applies to the smaller tool room machines as well as to the larger millers. Where machines are not so equipped it would undoubtedly pay to apply a cooling compound system.

GRINDING CUTTERS.

The use of properly ground cutters is especially essential in order to obtain the maximum output of milling

machines, and unless this is attended to, high rates of speeds and feeds cannot be expected. Considering for the present the outside of the tooth, it is very necessary that it be ground to give the correct amount of back clearance. Too sharp an angle will cause the cutter to chatter, hook in and produce rough surfaces. Too little clearance will cause the cutter to drag and prevent proper cutting. Many a cutter has been condemned on account of too sharp teeth or angle where a slight removal of the keen edge either by grinding or wear would have remedied the trouble. No hard and fast rule can be given governing the amount of clearance, as different metals will require different degrees. For steel such as used largely in locomotive construction, a back clearance of about three degrees appears to be satisfactory for a 4½-in. cutter. It is a good plan to occasionally measure this back clearance which can readily be done by a bevel protractor. The data obtained will be available for grinding future cutters. Sheet steel gages made to the proper angle for testing cutters after being ground will be a great help. When a happy medium has been arrived at for grinding the back angle, it will be found that cutters as they come from the grinding machine will go off at once without nursing as is often the case with improperly ground cutters. Some of the cutter grinding machines are arranged so that the amount of back clearance can be adjusted and machines having this attachment should be carefully studied and set to give a properly ground cutter.

To grind the front rake of a tooth or the undercut surface is somewhat difficult on the average universal grinding machine, but it can be performed in a fairly satisfactory manner by setting the grinding spindle at right angles to the groove in the cutter and using a cup grinding wheel. The cutter must be passed back and forth holding its face against the wheel. Some of the later grinding machines are equipped with spiral grinding attachment that will grind this surface nearly perfect. Even with the hand method, however, the results obtained in the way of longer life between grindings, fully justifies the additional expense of this one grinding. As pointed out before, this grinding of the face of a tooth may be likened to the grinding of the top face of a lathe tool, and who would think of making use of a lathe tool that had not been ground on the face after hardening. A smooth surface is absolutely necessary to prevent the chip dragging on the lathe tool or the cutter tooth face. The question as to how often a cutter should be ground may be answered by observing the chips. When these show a discoloration in spite of a liberal supply of compound it usually indicates that the cutter teeth are either dull or broken.

MANUFACTURE OF CUTTERS

The cutters principally referred to above are the coarse tooth, the undercut spiral, the face mill and the end mill, and these are now regularly supplied by several tool manufacturers. These concerns make cutters by the hundreds with up-to-date appliances for milling, drilling, grinding, hardening, etc., and can, without a doubt, produce cutters cheaper than railway shops. The manufacturers generally replace any cutter developing flaws either in hardening or in use and in view of the fact that railway toolrooms are generally crowded with work, the question of the purchase of all standard cutters should be favorably considered.

Railway shops, like a number of manufacturing concerns, generally have a large number of old fine tooth carbon steel cutters on hand and it looks like a crime to scrap them. However, in light of what is being done every day in way of high speed milling, and where the labor cost is very much less than with the older cutters, there can be no question of the economy in providing new equipment of up-to-date high speed cutters for milling the parts entering into locomotive and car construction. We eliminated the carbon steel lathe tools and should do the same with carbon milling machine tools.

POWER REQUIRED

For the same conditions and machine the power required will depend largely on the design of the cutter, and its sharpness and good cutters having undercut teeth and milling ⅛ in. to 3/16 in. deep will require ¾ hp. for each cubic inch of soft steel removed per minute. A large No. 5 knee type milling machine on heavy work will consume from 15 to 20 hp. However, it should be borne in mind that the actual cutting is only going on a small per cent of the time with the modern milling machine as the cuts are taken very quickly and the actual horsepower hours consumed per day will not be excessive. As a rule it will be found that the time of setting the pieces in the machine will generally equal the time of actual milling.

ARBOR AND ARM SUPPORTS

It would be quite difficult to give any definite rule governing the size of the arbor to be used, but most railway shops call for heavy cutting, and to accomplish this large arbors are necessary. On the other hand, large arbors require large cutters which are more expensive than smaller ones. The chattering of a cutter which is very objectionable, on account of rough work and dulling the cutter edges is often the result of using too small an arbor or improper arm support. For general work the 2-in. arbor can be recommended. However, with this large arbor, use must be made of as many arm braces as possible. A good rule is to use all the braces that are possible, as there is no danger of using too many.

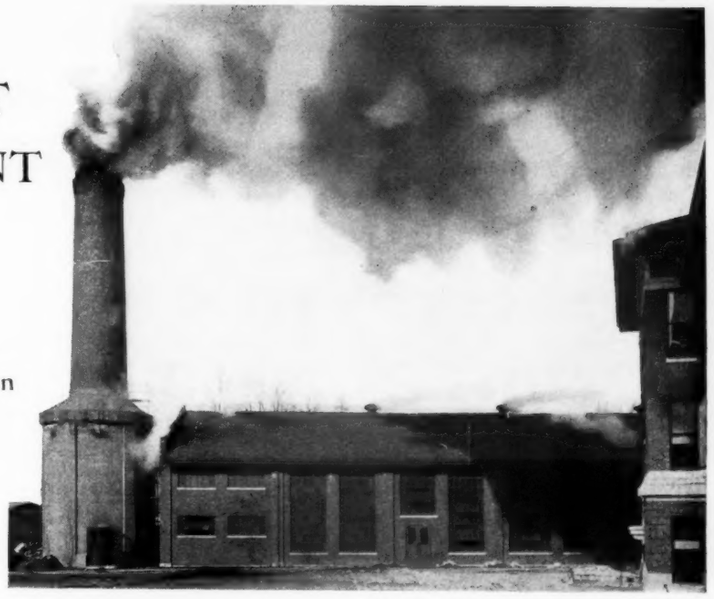
In this article which has only mentioned a very small per cent of the jobs that can be done on milling machines, cutting speeds and feeds have been given that may appear high when compared to practices of a few years ago. They are really conservative, however, and can readily be duplicated in every day practice. A number of concerns are now milling at speeds very much faster than what has been mentioned. Of course, in order to obtain high speeds it is necessary to keep cutters and machines in good condition. The question of holding the work is about as difficult as any that will be encountered, as high speed milling exerts a very heavy thrust on the article to be milled.

Attention has been called to the large No. 5 milling machine. It may be argued that smaller and cheaper machines are strong enough for railway work and this is true for a large number of parts, but experience with wheel lathes, center lathes, turret lathes and boring mills as well as milling machines has demonstrated that a strong and heavy machine tool will turn out more work per day and with less grinding of tools than a lighter machine.

Traveling in Modern Russia.—A most entertaining picture of present-day railway travel in Russia was recently contributed to the Daily Mail (London), by Alexander M. Thompson, a well-known writer on labor matters. Mr. Thompson desired to travel from Petrograd to Moscow, and was "enviously congratulated" by his Russian friends when he succeeded, through a friendly commissionaire, in booking a sleeping berth at less than four times the official price. Mr. Thompson's train, the last of the day, was due to start at 10 o'clock on a Tuesday. When he arrived at the station, in very good time, he was informed that the train had started three hours earlier. "When I told my Russian friends who had congratulated me on my extraordinary good fortune in securing the ticket," continued Mr. Thompson, "they merely shrugged their shoulders comfortably and murmured the magic word, Nitchevo (never mind), and assured me 'That's Russia.' Meanwhile I wonder when I shall reach Moscow, Nitchevo."

THE UNIVERSITIES AND EQUIPMENT DEVELOPMENT

Many Problems Can Only Be Solved by the Designer on the Basis of Facts Obtained by Scientific Investigation



The University of Illinois Test Plant in Action

THERE are many problems arising in the design of cars and locomotives, in his efforts to solve which the designer is forced to depend largely upon more or less unsupported opinions. Many of these questions would be susceptible of a precise settlement were the necessary data at hand. More particularly in the case of locomotives, this applies both to the proper proportioning of various parts of the design for the most economical performance and to the design of many of the details from the standpoint of strength and ease of maintenance. Our methods of improving design, based largely upon a superficial observation of performance in service, have too often led to a local treatment of the symptoms, rather than the location of the cause of the disease which is essential before the proper remedy can be applied.

The solution of many of these problems requires a thorough, scientific investigation with the accumulation of much data, the prosecution of which few railroads have either the facilities, the organization, or the money to undertake independently.

There are several universities equipped with laboratory and test plant facilities which are ideal for use in the study of many of these problems. Of course it must not be forgotten that the primary purpose of these facilities is the preparatory training of men in the engineering profession. But they are kept busy only a small part of the time in purely educational work. Why can they not be devoted to the study of practical problems to the great advantage not only of the transportation industry, but of the men who are receiving their training in these institutions?

IN many respects our methods of locomotive design have hardly advanced beyond the "rule-of-thumb" stage.

There is need for accurate data on which to base a logical proportioning of boilers.

Our knowledge of the comparative value of a great variety of locomotive fuels, and of the conditions under which they may best be burned, is extremely limited.

The available knowledge on the subject of locomotive drafting is very crude.

There are parts of the running gear for which the present methods of designing for strength are not wholly satisfactory.

There is a real need for a well-planned and painstaking study of these subjects.

Why not untilize the test plant and laboratory facilities of universities equipped for teaching railway mechanical engineering, in the investigation of these subjects?

The universities and the railroads, both, would benefit from such a course.

THE FIELD FOR TEST PLANT STUDIES

Inquiry as to the practicability and desirability of such a course was made among a number of engineers who are interested directly in the design of equipment. The way in which they responded to this inquiry indicates a very deep interest in the subject. This was especially true on the part of locomotive designers.

Suggestions as to subjects suitable for this kind of investigation were made by a number of the best known engineers in the field of railway equipment design. While the test plant is of value only in dealing with locomotive problems, there still are possibilities for the employment of impartial investigations for the development of data much needed by the car designer.

As will be evident from a study of the following paragraphs, the extent of the field outlined by these suggestions presents great possibilities for practical usefulness for the available university locomotive testing plants, as well as other laboratory facilities.

In order to define clearly the scope of the field in which such investigations are practicable it must be borne in mind that there are two kinds of development in equipment design—improvements by invention and improvements resulting from the gradual evolution of existing things. Inventions frequently require years of preliminary work and trial before reaching a practical stage of development. Such improvements may be quite revolutionary in their application as compared with existing designs. The highest development of existing types of design requires patient investigation and testing in order to establish their limitations, and rules and formulas for their use.

Obviously the first class does not lend itself to co-ordinated efforts and it is in the second class that the co-operation of the universities should be enlisted, since organization and laboratory facilities lend themselves more readily to such tests and investigations. The investigations to which our educational institutions lend themselves, must, of course, be of a strictly impartial nature and the results made available to all designers.

BOILER AND FIRE BOX DESIGN

The need for a more scientific knowledge of the conditions affecting the many phases of the problem of proportioning locomotive boilers and fireboxes is very generally felt. Here is a list of pertinent subjects for investigation:

1. The effect of grate area upon firebox evaporation.
2. The effect of firebox volume upon firebox evaporation.
3. The combined effect of grate area and volume upon firebox evaporation.

The firebox receives practically all of its heat by radiation from the fuel bed and flames, and the amount of heat radiated depends upon the temperature and area of these heating surfaces; but there is no method of approximating them. Does the heat from the fuel bed pass through the flames above, or is it absorbed by the flames and radiated by them to the firebox heating surfaces? In other words, knowing the temperature of the flames and the incandescent fuel on the grates, can the firebox evaporation be calculated by adding the area of fuel bed radiating surfaces to the area of the flames; or must flame area alone be considered?

The information needed to answer these questions could be secured by running a series of tests with fuel of different characteristics. For instance, coke (which burns without any flame) could be used in a series of tests to determine the firebox evaporation, followed by another similar series of tests using medium or low volatile coal, and a third series of tests using high volatile coal.

Such a program would, no doubt, present many difficulties; but a university equipped with a modern testing plant, and with sufficient funds provided for this work could overcome the difficulties, and information could be made available which would be of vital importance for a correct understanding of the fundamentals of firebox design.

4. The length and volume of combustion chambers required for the complete combustion of various kinds of coal.

At present there is no definite knowledge as to the value of combustion chamber space. How far should we go in installing combustion chambers? What should the length be for a specific grade of high volatile, low volatile, or anthracite coal?

5. The relation of tube length to diameter necessary for the highest combined capacity and efficiency.

This should be worked out in conjunction with combustion chambers, as the lengthening of combustion chambers necessarily shortens the tubes. Some work on this subject has been done by the Pennsylvania Railroad at its Altoona testing plant, and by the Babcock & Wilcox Company. The work which has been done, however, has not covered a sufficiently wide range of conditions and the conclusions reached are not definite enough to be wholly satisfactory.

Many roads have been experiencing trouble with locomotives of the 2-10-2 type because of their poor steaming qualities. This is due primarily to their long tubes and the inadequacy of the front end arrangement. Boiler capacity and efficiency cannot be secured by merely increasing the boiler heating surface. Indeed, there are probably many locomotives in service the boilers of which have more heating surface than they need.

No attempt has recently been made to use a tube in the locomotive boiler smaller than two inches in diameter. To do so has seemed impracticable because of the impossibility of keeping small tubes open.

But are the troubles arising from the accumulation of solid matter and the plugging of tubes, due primarily to the size of the tubes? Is not the real cause to be found in the conditions leading to imperfect combustion in the firebox? With a firebox having sufficient grate area, combustion chamber space and flameway, a means for thoroughly mixing the gases and an air supply sufficient to approximate perfect combustion, could not the plugging of tubes be eliminated, or so greatly reduced as to make the use of tubes smaller than two inches in diameter entirely practicable? It is known that the efficiency of the tubes increases as the diameter decreases, and the successful use of long combustion chambers with short tubes depends upon the possibility of using tubes smaller than the present diameters.

6. Boiler tube performance.

As a part of other investigations already outlined or as a separate study, it might be of value to determine the evaporation of boiler tubes for different portions of their length, giving more information as to the curve of temperature drop between the firebox and the smokebox than is now available. In this connection, a study of the smokebox vacuum necessary to pull the gases through tubes of varying length and inside diameter would be of value.

It might be possible to arrive at satisfactory conclusions in such a study by experimenting with single units. For instance, a boiler tube 2 in., 2¼ in. or 2½ in. in diameter could be inclosed in one of sufficiently larger diameter to contain about the same amount of water as is actually heated by a single tube in a locomotive boiler. These units could be made up in different lengths and the necessary temperature and draft readings determined with a considerable degree of accuracy. The hot gases should be supplied from a furnace or some other source giving a uniform flow and controllable temperature.

FUELS AND COMBUSTION

The whole subject of the relative value of a wide range of fuels is awaiting the kind of attention which can be given to it only where test plant facilities are available. Invaluable data might be secured from a series of comparative tests of oil fired and coal fired boilers, and pulverized fuel combustion offers a virgin field for investigation.

Tests to determine the most efficient rate of combustion, with due consideration of the proper balance of fuel efficiency, over-all efficiency and locomotive capacity would undoubtedly lead to better firebox design.

DRAFTING

So far as is known, there have never been any reliable tests made to determine the effects of air openings through the grate upon firebox temperatures and the completeness of combustion. Firebox temperatures, proper length of flameway, and combustion chamber space depend upon the air supply. There are many railroads in this country using grates entirely unsuited to the character of the coal that is being burned. Probably most of them could use grates with more air openings to considerable advantage. In a general survey of locomotive drafting there is much to be learned from a careful study of ash pan and grate design.

The so-called "Master Mechanic's front end" has never been adopted by all the railroads in this country, possibly for the reason that it has not given satisfaction under all conditions. There can be no doubt but that there is ample room for improvement in front end arrangement, particularly as to the exhaust pipe and nozzle.

If the efficiency of the exhaust depends upon the entraining action of the steam, there is no logical reason why the present form cannot be improved upon by increasing the entraining surface of the jet. Recent tests show that irregular shaped nozzles, such as those of the rectangular, dumb-bell or internal projection form possess some advantages over the ordinary circular type. The theory of the entraining

action of the jet accounts for this, but how far this theory holds true in practice has not yet been definitely fixed.

There is still room for further investigation to determine the most efficient diameter and shape of smoke stack.

Considerable development work on the application of mechanical draft to locomotives has been done by H. B. MacFarland, engineer of tests of the Atchison, Topeka & Santa Fe. The results obtained, however, have not been conclusive as to the extent to which increased efficiency in the production of the draft may be obtained by the substitution of an adequate mechanical draft system for the present exhaust jet.

SUPERHEATING

Investigation might possibly be made of the over-all efficiency obtained with the superheater, considering the drop in pressure through the superheater units. In this connection a study might be made of the design to minimize the pressure drop through the superheater.

FEEDWATER HEATING

In an investigation of this subject, a determination of the per cent of the weight of steam used which can be diverted without detriment to the draft, would be of interest.

STEAM DISTRIBUTION AND ECONOMY

From the throttle valve to the exhaust pipe there are many features of the steam conveying and distribution system, the design of which is based very largely upon tradition. In many cases material improvement might be effected if accurate data as to the effect of varying proportions, sizes, etc., based upon a thorough investigation, were available for the designer. Some of the questions involved are:

What is the effect of varying sizes and proportions of throttle, dry pipe and steam pipe upon the pressure drop between the boiler and steam chest?

What is the best diameter of piston valves and the proper shape of steam ports from the standpoint of efficient steam distribution?

What is the most efficient clearance for locomotive cylinders and what value setting should be used to provide the greatest steam economy for the starting, accelerating and speed requirements of different classes of service?

An investigation of uniflow cylinders.

The determination of leakage past piston and piston valve packing rings.

MECHANICAL INVESTIGATIONS

In the past few years the use of main rods with solid back ends forged integral with the rod has greatly increased. There have been numerous failures around the opening of this type of rod. The only remedy so far applied has been to add more and more metal to the section, making it larger and heavier, but with no accurate data upon which to base calculations for strength. In other words, the design of this detail has been developed by "cut and try" methods.

There is comparatively little data on the strength of main rod sections, considered as columns. It has been suggested that there is a possibility of increasing the working stresses now used, particularly when certain high grade steels are utilized. The determination of a satisfactory answer to this question would involve tests of the column action of full size main rod sections.

For many years past locomotives have constantly been growing larger and the same principle of equalization has been maintained that was used upon the smaller and lighter locomotives built for rough track conditions no longer commonly existing in this country. There has recently been a tendency to depart from these established methods of equalization and to make a partial approach to what may be termed the European method of spring suspension. This is a problem about which we know very little and the importance of which is gradually becoming realized by railroad men.

The investigations at the time of the Woodlawn wreck on the electrified division of the New York Central developed the fact that there was practically no experimental data as to flange pressures and tracking of rigid wheel bases such as are used on locomotives, when operating around curves. Since that time some theoretical studies of this question and a few actual tests have been made. The extent of the work so far done, however, has not led to results which are generally considered conclusive. This is one of the most important questions confronting the designer and one which is very well suited to more extensive experimental work. A study of the resistance of various types of engine truck centering devices would also be of value in a general study of the tracking of locomotives. These investigations would require road tests.

For many years locomotives have not only been constantly increasing in size and capacity through the development of new types, but axle loads have been very materially increased on all types. As a result axles have increased in diameter until now it is not unusual to find them with journals as large as 18 in. in diameter. An investigation of the limiting peripheral speed of bearings in relation to the unit bearing pressure would furnish the designer with some much needed data. Closely related to this subject is the question of the most efficient shape of crown bearings from the standpoint of lubrication and freedom from heat. The two would require co-ordinate investigation.

This is only one of the investigations which would be required in a thorough general survey of the internal resistance of the locomotive and tender, the results of which might be the basis for refinements in running gear design.

CAR DESIGN

Formulae for the design of the various members of cars, both passenger and freight, are based upon theoretical analysis of the stresses involved. Would not a series of tests laid out to prove the correctness of these formulae, and especially to establish correct design of connections, lead to much greater certainty in securing well balanced designs? The growing weight of equipment is getting to be a matter for serious consideration. In a design not perfectly balanced, where the strength of many details is in excess of the strength of the weakest points of the design, it is obvious that unnecessary weight is being included.

No doubt there may be differences of opinion among engineers as to the advisability of attempting to solve some of the problems mentioned by impartial technical investigations, as suggested. On the other hand, no doubt, other subjects suitable for study in the laboratory or on the testing plant will suggest themselves to each individual who is thoroughly conversant with the many difficult problems confronting the locomotive designer. In the list of subjects mentioned here alone, there are enough that are beyond controversy to indicate very clearly the possibilities for the more intensive utilization of the facilities of the universities equipped for teaching railway mechanical engineering.

It is hardly necessary to call attention to the fact that in the conduct of such investigations some concessions might often be necessary from the purely academic point of view, in order that the results obtained might square with economic conditions and the many limitations within which the designer must work. In meeting these conditions, however, it would probably not be necessary entirely to divorce these practical studies from the purely educational utilization of the laboratory and test plant facilities. Would not the practical study of such problems in the university laboratory and testing plant afford the engineering student an opportunity to acquire a conception of the practical limitations under which he must apply his theoretical training, which so many college graduates lack today?

INCREASE ENGINE TERMINAL OUTPUT

ONE OF THE GREAT strategic points in the railway battle front is the engine house. It is the work of the men at this point that has contributed largely to the success with which the railways have been able to meet the greatest demands for transportation in history. It is a point that must be reinforced both by men and by facilities. On some roads it is the neck of the bottle on which concentrated effort must be placed. The suggestions given in the following communications will help to solve some of the problems:

THE RAILWAYS of this country need locomotives. The demands of our Allies make it impossible for us to buy what is needed to replace those that are obsolete and which are no longer fit to run. We must get more service from our existing power. One way is to handle the locomotives more rapidly at the engine terminals. This requires a good roundhouse organization and adequate terminal facilities.

F. P. Roesch of the El Paso & Southwestern tells how these facilities may be improved on any railroad at the present time. F. J. Harrison mentions improvements in enginehouse organization on the B. R. & P.

All of the articles in this series contain concrete suggestions which will lead to decreasing the time a locomotive spends in the terminal. Above all things, the locomotive must be sent out of the terminal fit to do its full work. Adequate supervision and inspection are absolutely necessary.

IMPROVE THE ENGINE TERMINAL FACILITIES

BY F. P. ROESCH
Master Mechanic, El Paso & Southwestern

When power is in demand, requiring a quick turn, the critical point is outside, and not inside, of the roundhouse. No doubt many will take exception to this statement, but I believe afterthought will prove to them that this is correct.

The number of men, mechanical facilities, tools, etc., inside of the roundhouse are usually adjusted to meet the demand. Conditions are so variable at different terminals that no hard and fast rule, in so far as organization is concerned, can be laid down. However, regardless of the character and efficiency of this organization, it is axiomatic that until there is something to work on the organization may as well be non-existent. In other words, the inside facilities are valueless until the engines requiring them get into the roundhouses. Therefore, the critical point is outside.

Visit the average terminal and see how they are fixed for track room, tracks to and from the turntable, cinder and inspection pits, coal, water, supply and sand facilities, and the point at once becomes clear. When we realize that results cannot be obtained with poorly arranged, inadequate or congested terminals, and these matters are corrected, a long step will be taken toward the conservation or full utilization of motive power.

The matter of roundhouse organization has repeatedly been well covered by other writers and as in this matter local conditions must govern no reference will be made herein covering this feature, except a passing reference to outside inspectors, as these can be utilized to good advantage in all cases, regardless of inside organization.

An analysis of the terminal movement would, therefore, indicate the following:

Inspection Pit.—The first requisite, regardless of whether the power is pooled or assigned, is a proper inspection pit with competent inspectors and helpers. In organizing this force, use men as helpers who can make repairs that do not require a machinist, such as setting up wedges, keying rods, tightening loose nuts, applying split and cotter keys, etc., the helper to follow the inspector and look after these details as directed. Such matters can be handled on the inspection pit in this manner in less time than it would take the inspector to write out or report the defects. The object in doing this work on the inspection pit is to have wedges set up while boxes and journals are warm and ex-

panded and to have injectors, air-pumps, etc., tested under full steam pressure.

Cinder Pit.—The next move is to the cinder pit. The capacity and length required depend on the cinder handling facilities. But in every case too much pit for average business is far better than too little or just enough, as the cinder and engine capacity of this pit governs the time required for knocking fires and cleaning ash pans.

Turntables.—The next move is on to the turntable. This is a weak point in the average terminal—often too short, requiring slow movement, extreme care and nice adjustment for spotting of the locomotive to balance, and, also, too frequently, hand operated. Labor is too scarce today and time too valuable to put up with the short hand-operated turntable. Motors should be used, either air, gasoline or electric. If air, it should preferably be furnished from the shop compressor.

Roundhouse.—The next move is into the roundhouse and here, aside from the force employed, three distinct items enter largely into the time element, namely, boiler washing facilities, firing up methods and steam pressure on roundhouse blower line. For washing the boiler effectively, quickly and without damage, the use of a hot water system is imperative. To illustrate the possible saving in time, a table is shown covering actual results daily obtained, as compared with the previous system of cold water washing.

HOT WATER SYSTEM.

Class Eng.	To Empty Boiler	Time used Washing	Filling	Get 100 lb. Steam	Coal (lb.)	Water
F 8 S	40 min.	1 hr. 40 min.	18 min.	41 min.	1,212	....
G 1	45 min.	1 hr. 10 min.	20 min.	45 min.	1,318	....
F 3 S	50 min.	1 hr. 25 min.	25 min.	47 min.	1,152	....
F 6 S	30 min.	1 hr. 10 min.	18½ min.	39½ min.	1,201	....

COLD WATER WASHOUT SYSTEM.

Class Eng.	To Cool	To Empty	Total	Washing	Filling	Get 100 lb. Steam	Coal (lb.)	Water Est'd (Gal.)
G 1	2 hr. 5 min.	1 hr. 15 min.	3 hr. 20 min.	1 hr. 10 min.	55 min.	2 hr. 10 min.	2,110	3,500
F 8 S	2 hr. 20 min.	1 hr. 20 min.	3 hr. 40 min.	1 hr. 30 min.	60 min.	2 hr.	1,896	3,500
F 6 S	2 hr. 18 min.	1 hr.	3 hr. 18 min.	1 hr. 13 min.	55 min.	2 hr. 7 min.	2,014	3,500

SAVING IN FAVOR OF HOT WATER WASHOUT SYSTEM.

Class Eng.	Time	Water (Gal.)	Coal (lb.)
F 6 S	4 hr. 55 min.	3,500	813 plus 30 equals 843
F 8 S	4 hr. 51 min.	3,500	684 plus 30 equals 714
G 1	4 hr. 25 min.	3,500	792 plus 30 equals 822

AVERAGE FOR ALL FREIGHT SERVICE.

Time	Water	Coal
4 hr. 55 min.	3,500 Gal.	759 lb.

SAVING FOR TEN ENGINES WASHED OR WATER CHANGED DAILY.

47½ engine hours @ $50 per day	$100.00
3,500 gallons of water @ 6 cents per 1,000 gal	2.15
7,590 lbs. of coal @ $6.91 per ton	26.10
Total	$128.15
Less interest and depreciation on $10,000 investment	7.56
	$120.59

With the hot water system the boilers are washed with water at pressure of 125 lb. and at a temperature of 150 deg., and are filled with water at a temperature of from 212 deg. to 215 deg. Consequently, when the boilers are filled the water is already beginning to make steam. Another item to be considered is that during the blowing off and filling periods the roundhouse is not full of steam and noise, which enables men to work about the locomotive in comfort and safety.

Firing up.—After the boiler is washed and filled, the proposition is to get steam as rapidly as possible. Loading a tank with scrap wood is expensive, time wasting and dangerous. Expensive, in that, even though the wood used is scrap, much better results can be obtained otherwise. Time wasting, in that it takes time to throw it on and interferes with the hostler, or others, getting on or off the engine. Dangerous, in that it is liable to fall off, catch on roundhouse doors, or to cause personal injury to the men as they may trip over it while climbing on or off the locomotive. A bucket full of sawdust or mill shavings saturated with one-half gallon of fuel oil spread evenly on a 4-in. bed of coal will cost less, will kindle a fire more evenly and quickly, will eliminate all possibility of nails, spikes, etc., getting into the grates and will leave the fire in much better condition than any scrap wood kindled fire. The scrap wood can be used to much better advantage elsewhere.

Roundhouse Blower.—In order to stimulate the fire, forced draft is necessary. This means a blower line of sufficient capacity to carry a pressure of not less than 50 lb. Too frequently do we see roundhouses with a small exposed blower line of a capacity so restricted that if three or more blowers are hooked to it at the same time no blower receives sufficient steam to create the required draft, with the result that either some or all of the engines are delayed.

Storage Tracks.—When the roundhouse forces are through with a locomotive, if roundhouse room is required, it should be moved out; and this again means storage tracks on which locomotives can be stored until they are called, so as not to interfere with in- or out-bound power. On the outbound movement sand, water, coal and engine supplies should be taken, the facilities for taking on these supplies to be so located as to cause no delay.

The above refers to the usual daily movement of all locomotives requiring boilers washed or water changed and the facilities named can, and should be, installed in every terminal where 25 or more locomotives per day are washed and turned. Only those who have been "up against it," as the saying is, realize the enormous loss of time due to poor outside facilities and old fashioned low pressure cold water boiler washing methods.

LOCOMOTIVE TERMINAL DELAY

There are terminals where locomotives stand from six to ten hours waiting their turn on the cinder pit, all of which time could be conserved and utilized to handle trains over the road. An increased force under such conditions would necessitate sufficient men to handle the peak load and, consequently, entail a loss during slack hours, even if men were available. At the present time, however, when labor is at a premium, facilities—under which term can be included everything such as machinery, tracks, pits, etc.—must take the place of hand labor if results are wanted.

In a paper* read by G. S. Goodwin before the Western Railway Club in February, 1915, on "The Value of a Locomotive," he gives the average roundhouse detention as 6 hr. 49 min. At a terminal the writer has in mind where the facilities named above obtain, the average time locomotives are held at terminals, including those receiving the monthly, quarterly and annual Federal test, runs from 4 hr. to 5 hr. 15 min., figuring from the time the locomotives reach the terminal until again set out ready for service. This shows a saving over Mr. Goodwin's figures of not less than 1 hr. 30 min. per locomotive, taking the longest detention into consideration. Another means for decreasing terminal engine hours is by turning the engines promptly at intermediate terminals and send them back with fresh crews.

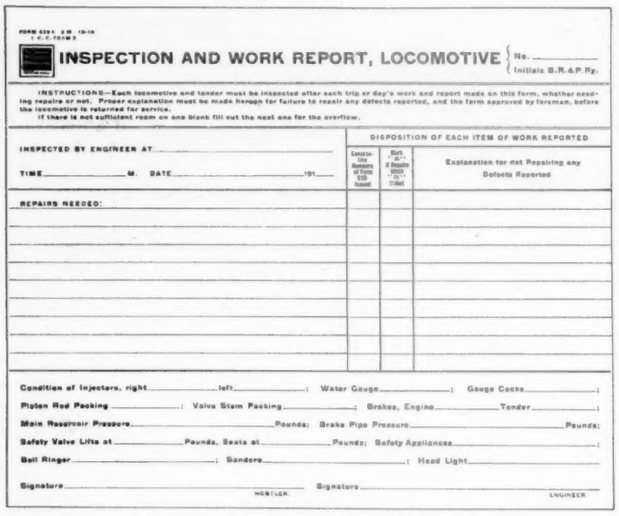
In justice to those who do their railroading in cold countries, it should be stated that the figures herein shown apply where weather conditions are ideal, in that, at no time, is the weather so inclement that the inspection and other details mentioned cannot be handled outside.

* See *Railway Age Gazette, Mechanical Edition*, March, 1915, page 118.

METHOD OF SUPERVISING RUNNING REPAIRS

BY E. J. HARRISON
Superintendent of Motive Power, Buffalo, Rochester & Pittsburgh

We have organized gangs in our engine houses under a gang leader, which consist of from two to six men—that is, we will have a gang handling driving box work, one shoe and wedge work, one crosshead and piston work, one spring rigging, one firebox and flue work, one tender work, etc.—and it is working out very successfully. We have also placed at roundhouses a man that we call "final inspector." When a locomotive arrives at the cinder pit it is inspected by a man who reports the repairs needed on Form 829-A (Fig. 1)


INSPECTION AND WORK REPORT, LOCOMOTIVE No. ____ Initials B.R.&P. Ry.

INSTRUCTIONS—Each locomotive and tender must be inspected after each trip or day's work and report made on this form, whether needing repairs or not. Proper explanation must be made hereon for failure to repair any defects reported, and this form approved by foreman, before the locomotive is returned for service.
If there is not sufficient room on one blank fill out the next one for the overflow.

INSPECTED BY ENGINEER AT ____
TIME ____ M. DATE ____ 191__

DISPOSITION OF EACH ITEM OF WORK REPORTED

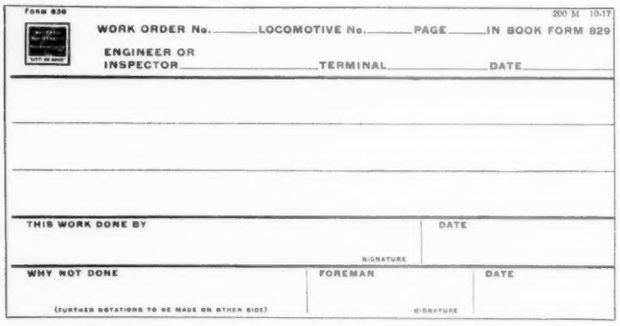
REPAIRS NEEDED:	Check No. and Initials of Form 830 Issued	Mark "O.K." if Repairs Made (Do not Initial)	Explanation for not Repairing any Defects Reported

Condition of Injectors, right ____ left ____; Water Gauge ____; Gauge Cocks ____;
Piston Rod Packing ____; Valve Stem Packing ____; Brakes, Engine ____ Tender ____;
Main Reservoir Pressure ____ Pounds; Brake Pipe Pressure ____ Pounds;
Safety Valve Lifts at ____ Pounds, Seats at ____ Pounds; Safety Appliances ____;
Bell Ringer ____; Sanders ____; Head Light ____

Signature ____ HOSTLER. Signature ____ ENGINEER.

Fig. 1.—Inspectors Repair Report.

and this form is then sent to the roundhouse clerk by a boy whom we call a "runner." The clerk then copies the work in the work report book that is reported by both the engineer and the inspector. Each individual item of repairs is made out on a work order, Form 830 (Fig. 2), which the boy takes to the roundhouse foreman who distributes the work to


FORM 830 200 M 10-17

WORK ORDER No. ____ LOCOMOTIVE No. ____ PAGE ____ IN BOOK FORM 829

ENGINEER OR INSPECTOR ____ TERMINAL ____ DATE ____

THIS WORK DONE BY ____ DATE ____ SIGNATURE

WHY NOT DONE ____ FOREMAN ____ DATE ____ SIGNATURE

(FURTHER NOTATIONS TO BE MADE ON OTHER SIDE)

Fig. 2.—Work Order for Engine Repairs.

the gang leaders. After the work is done the slip is given to the "final inspector" who determines whether it is properly done or not, and he does not "O. K." it unless it is properly done. If it is improperly done he calls the roundhouse foreman's attention to it, and he gives it immediate attention. After the work is "O. K." and the slip is signed by the "final inspector," it is then delivered to the roundhouse foreman. This gives him an opportunity to see the slip before the work is distributed and after the work is completed. He then notifies the train despatcher that the engine is ready for service. At the end of the day these slips are laid on the general foreman's desk.

KEEP ENGINES ON THE ROAD

BY F. W. TAYLOR
Superintendent of Motive Power, Missouri, Kansas & Texas

The "slogan" at roundhouses or terminals should be, *"Keep engines on the road and stop failures,"* and no locomotive should be despatched unless the foreman is reasonably sure it is in condition to make a successful round trip.

The cleaning of fires and coaling should be done in the shortest possible time. The filling of sand boxes should be done at the same time the tank is filled with water.

Hot-water washing out and filling up plants will increase the life of the boiler, reduce boiler repairs and shorten the time to raise steam and should be in every terminal.

Locomotives should be turned on power driven turntables.

Each terminal should be equipped with either oxy-acetylene or electric welding and cutting outfits, with a competent man to operate them.

Labor saving devices should form a part of every roundhouse equipment.

The firing up of locomotives should be handled with despatch, and for this there should be an efficient blower line.

The enginemen can materially assist in the quick turning of locomotives at terminals by making clear work reports.

The little repair jobs on locomotives should receive prompt attention, so that they will not grow and multiply until they become big enough to hold the locomotives out of service.

Last but not least, a thoroughly competent and resourceful foreman should be placed in complete charge of all roundhouse work.

THE INDIVIDUAL IS THE VITAL FACTOR

BY JOHN C. MURDOCK
Allston, Mass.

The most important and patriotic duty a man can perform for this country at this time is to work just as hard and as steady as he possibly can, and at the same time keep in good spirits with the thought of having applied himself to something worthy of a supreme effort.

My experience with enginehouse work has been, that many things are done to satisfy the particular whims of some people. For instance, in ordinary times valve gears have been taken down and a small amount of slack taken up, and main rod and side rod brasses have been reduced and renewed, when they both may have gone longer, etc., because some person wanted his engine fixed up.

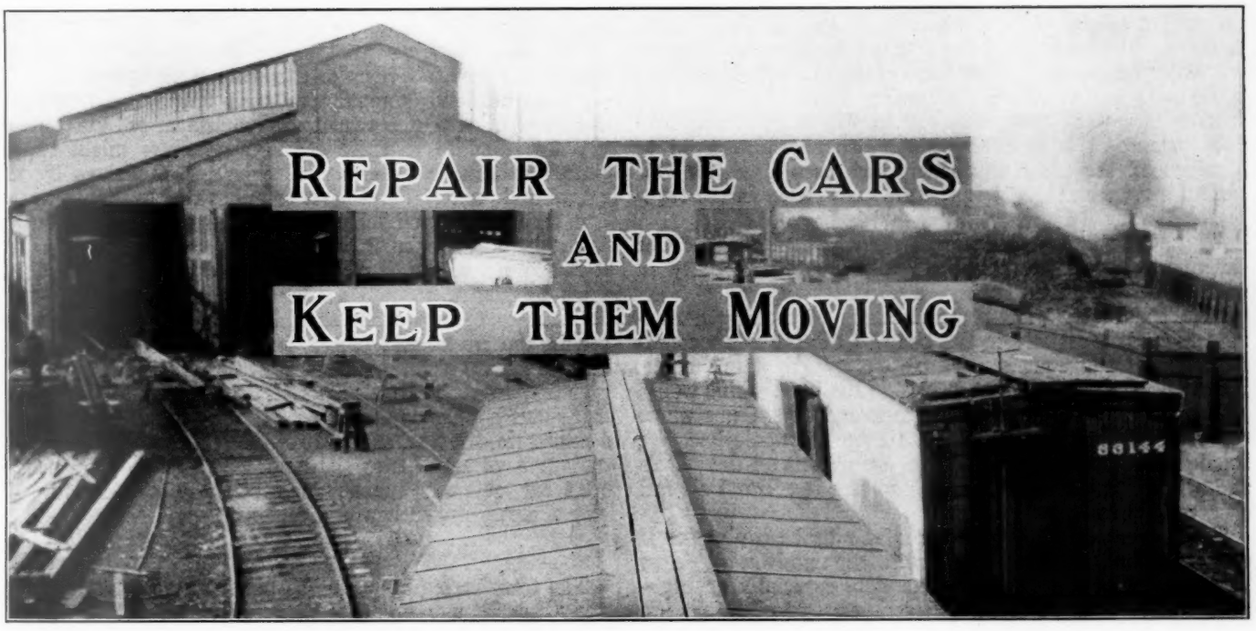
In extraordinary times supervision is the mainstay and the job should be run from the top down instead of from the bottom up. In making a supreme effort the persons in charge must be immune to criticism and work along with confidence and feel that every knock is a boost. The different members of the organization must get close together and pare down the individual wants and hobbies.

The engine despatcher should make a personal effort to so switch the locomotives that those will get inside first which are wanted first and in this manner keep the repair force working the locomotives out in rotation, thereby saving time lost in shifting from one locomotive to another.

The present situation calls for special exertion of the individual; each and every man concerned must make himself a committee of one to see that this is done. Everyone from the top down to the bottom should have this in mind and in running against "knocks" they should not let anything get in under the skin.

The railroads are the arteries of this country, transporting the potential power of its natural resources to the place where it will do the most good, and every individual should see to it, insofar as he is able, that he assists.

The slogan of today on the railways should be: "Work hard and everything else will take care of itself." This will be particularly true where there is plenty of supervision. Also—"Have confidence in your superior officers."



REPAIR THE CARS AND KEEP THEM MOVING

THE SUCCESS with which the railroads will meet the demand for freight cars during the remainder of the winter depends to a very large extent upon the despatch and thoroughness with which the cars are repaired and put through the terminals. During the past year only about 80,000 freight cars have been ordered for use in the United States and Canada. This is the smallest number ordered during one year since 1908. The situation is serious and demands that the greatest efforts be made to keep what cars there are in service and to keep them moving. With governmental control of the railways help is expected and without doubt before this article is read by many positive steps will have been taken to increase the freight car supply. Whatever assistance is given will not be felt for a few months at least and in the interim the car supply must be maintained at a maximum. The car repair and inspection forces can contribute very materially to this end.

> "ALL transportation systems . . . shall be operated as a national system of transportation, the common and national needs being in all instances held paramount to any actual or supposed corporate advantage. *All . . . rolling stock and other transportation facilities are to be fully utilized to carry out this purpose without regard to ownership.*"
>
> This is an extract from the first order issued by Director-General McAdoo. It will solve many problems for the car department forces. It is a command that many will be glad to obey. It should eliminate many misunderstandings regarding repairs to foreign cars. It makes it possible to settle many controversies promptly. There is now no "foreign car" except in name. The sole problem is to use the rolling stock to the fullest extent, holding the national needs "paramount to any actual or supposed corporate advantage."

REPAIR CARS PROPERLY AND PROMPTLY

Late in the spring the Executive Committee of the Special Committee on National Defense of the American Railway Association, about one month after its formation, issued an appeal to the railroads requesting that the number of freight cars under repair be reduced. This had its effect and an improvement was shown in the following months. With the tremendous business, however, and the shortage of labor there have been tendencies for the roads to neglect the smaller defects. Commenting on this fact J. C. Fritts, master car builder of the Delaware, Lackawanna & Western, says:

"One of the most important thoughts is that conveyed by the old saying we have all heard: 'A stitch in time saves nine.' At this time, when cars are so badly needed, along with the scarcity of labor and material, the general tendency, no doubt, will be to load cars, if they are able to handle the lading with any degree of safety, without making the small, minor repairs. This is a very serious mistake and will eventually result in the cars being taken in requiring heavy repairs. In reviewing my 29 years' experience in car maintenance, there is nothing so detrimental to the maintenance of equipment as to neglect the making of light or minor repairs in time to save a greater expense a little later on, as well as the loss of the use of the car."

Speaking further on the general subject of car conservation, he says:

"All railroads should endeavor to keep at the work of reinforcing some of their older types of cars by applying steel underframes and such reinforcements as in their judgment might be economical. I realize, of course, that in many instances it is hard to obtain material, as well as labor, but if every railroad throughout the country would do as much of this as it is possible for them to do, the general effect would, no doubt, be felt, as every time a weak car is made strong it increases the efficiency as a whole just that much.

"The railroad companies should put their oldest and weak-

est cars in special service, wherever there is an opportunity to do so. In making this statement, I have in mind observing on a certain road new cars, of the strongest construction, being used in ash-pit service, while the older and weaker cars were being handled in the heavy trains. In this instance, I believe very much better results could be obtained if the older equipment had been used for this special service and the strong, sturdy cars used in the regular coal traffic."

T. J. O'Donnell, arbitrator of the Niagara Frontier Car Inspection Association, calls attention to the necessity of making permanent repairs:

"We should all realize the necessity of making permanent repairs, especially to the body of the car when conditions and circumstances will permit, rather than 'toggle' the car up for the load that is in it at the time. This would apply mostly to sills, ends, door posts and other items where the load seems to catch the car more particularly. We should give particular attention to the defects on the wheels and all do our share of this work so that it will not all fall on a certain few repair points.

"The upkeep and maintenance of air brake equipment is very important and should be kept in our minds at all times. They should be given best of attention, especially on high-class freight such as stock, refrigeration and cars that are run for long distances."

DESTROYING CARS

Another master car builder tells of the extent to which his road is going in the matter of demolishing old cars. A short time ago the following instructions were issued:

"On account of the high prices and the inability to receive new equipment or material to rebuild cars, it is necessary that the practice of destroying cars badly damaged in wrecks (which was good practice in normal times) be changed until the end of the war or until conditions are more nearly normal.

"Any wood, composite or steel cars (except a few low side steel gondola or cinder cars) which are damaged in wrecks must not be burned, but must be brought into the shops and repaired. If all of the wood work is broken and destroyed, the metal parts must be loaded up and brought into the shops without dismantling, and the car rebuilt using the old metal parts.

"If the body of the car has been burned, the metal parts must be brought to the shop without dismantling and used to rebuild the car.

"The above includes box, coal, gondola, flat, stock, produce and refrigerator cars and all work and service cars, snow plows, etc."

DELAY TO FOREIGN CAR REPAIRS

On August 17, a circular was issued by the executive committee of the A. R. A. Committee on National Defense calling attention to the large amount of unnecessary delay in repairing foreign cars. When a railroad car shop repairs a freight car belonging to another road, and has to send to that other road for material, it has to bear not only the cost of the per diem charge on the car while it is waiting, but also the loss of the car in service; and in the present scarcity of cars this is a serious item. One large railroad found that there was an average delay of 14 days, from the date of its orders for material from owners, to be used on foreign cars, to the date the material was shipped; and a further delay of 31 days (average) from the time the material was shipped until it was received. These figures, very likely, may show the general average throughout the country.

Attention was called to the fact that the Master Car Builders' rules permit the use of unstandard parts under certain conditions, provided the car can be made safe and serviceable; and the association has recommended and urged members to take advantage of this provision of the rules.

A. M. Darlow, assistant to the president of the Buffalo & Susquehanna, referring to this same thing, says:

"Cars are held at repair yards for long periods awaiting the receipt from the owners of manufactured and special articles standard to those cars. These cars might be repaired and made safe to run without such delays by the use of such material and parts as are available. The American Railway Association recommended this practice but it is not being followed in some cases."

A superintendent of motive power of a road in the West finds occasion to make a similar criticism. He says:

"Further, car equipment should not be held by foreign lines for the owners to send repair parts. Any amount of equipment is tied up on foreign lines for weeks and months waiting, possibly, for some small repair part that could have been made and applied to the car and the car put in service with a minimum delay, were it not for the fact that there is a rule that says wrong repairs shall not be made to your neighbor's car without your neighbor being reimbursed for the cost of correcting such wrong repairs."

RUN, REPAIR OR TRANSFER

The transferring of loads has become a very live issue at many interchange points. One superintendent of motive power suggests that—"The ancient rule of 'Run, Repair or Transfer' should be adopted, it being understood that the receiving road, if it decides a transfer should be made, should make it at its own expense. If this were done much less transferring and holding of equipment would obtain."

Mr. O'Donnell says that one of the greatest improvements in the car situation could be made by selecting more carefully the equipment for loads at the original loading points. This would eliminate the transferring of load en route, which with the present labor shortage causes a serious delay. He speaks particularly of the manner in which lumber and heavy timber is loaded onto open cars such as those of the flat and gondola types: "A great deal of delay and expense could be overcome by a little more care exercised at the original point of loading by using the long timbers as the base of the load when possible to do so and putting the shorter timbers on the top, rather than throwing the timbers in the car promiscuously, which causes extensive shifting and weakens the side stakes and in many instances causes the transfer of the entire load."

In speaking at a recent meeting of the Niagara Frontier Car Men's Association, he said that the number of loads transferred in all yards in the Buffalo territory averages about thirty a day or 900 a month. Every means is being taken to reduce this number and get the car through the terminal without disturbing the lading. Many roads are splicing center sills, rather than attempt to hold up the freight and lading.

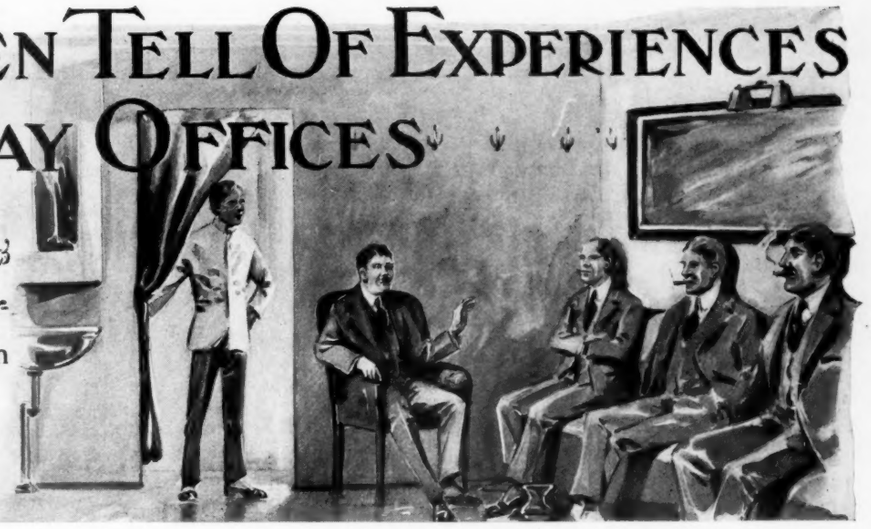
Other members of that association speaking on this subject called attention to the fact that as the cars were being much more heavily loaded at the present time that considerable more time was taken to transfer the loads. Some suggested that an examination be made by the immediate superior of the inspector to determine whether or not it is absolutely necessary to transfer the loads the inspectors mark for transfer.

The entire matter of interchange is one requiring the exercise of a great deal of common sense particularly at this time. The roads at the interchange points must co-operate and do everything in their power to forward the loaded cars onward in their journey. So absolutely necessary is this that the Commission on Car Service, which is a sub-committee of the Railroads' War Board, printed in bold face type at the bottom of its first general order:

In all cases, keep the cars moving and settle differences of opinion afterwards.

Supplymen Tell Of Experiences In Railway Offices

How to Reach the Big Boss and make a Favorable Impression upon him



IN ANOTHER ARTICLE in this issue chief clerks in the railway mechanical department tell of their experiences with supplymen and make suggestions looking toward closer co-operation between, as well as conservation of, the time and energy of both the supplyman and the railway officer. Supplemen sometimes feel hurt because of their reception in railway offices—and not always without cause.

At our suggestion a dozen or more successful supplymen have given frank expression concerning their experiences in railway offices. The following extracts from these expressions may be studied with profit by supplymen and railway officers:

I

GET DOWN TO BUSINESS

Since real business men evade the habit of taking their business affairs home, the same should apply to the supplyman who takes baseball, golf and other diversions into his customer's office; if he will be more prompt in getting to the business in hand, it will work out greatly to his advantage, as well as to that of the officials on whom he calls. For instance, the peddler enters, is seated, and occupies the first ten minutes in discussing the weather. If a few railroad officials would answer to, "Isn't this a wonderful day?" by "I have heard it so spoken of," several minutes of this discussion would be eliminated; but good nature is always penalized, and the official resolves that next time he will either be out or in conference.

II

DAY OF DISAGREEABLE RAILWAY OFFICER PASSING

I recall but one instance where I received a report from any of our representatives in regard to any but the most cordial receptions they have received from purchasing agents and other railway officials upon whom they are calling continually.

I think the day of the disagreeable railway official is passing and the railway men who receive the representatives of the large industrial concerns are business men with the full sense and realization of their problems and understand that it is to their own best interest, and the interests of the railroad companies which they represent, to cut out the high-handed important way which some of them have had in the past to their own disadvantage.

RAILROAD OFFICERS and foremen are always busy. In these days they are driven to the very limit to keep things going. Supplymen should remember this.

On the other hand, the railroads were never so greatly in need of labor-saving and capacity-increasing devices and equipment, or never so hard pushed for material and labor.

The interests of railway officers and supplymen are identical—to increase railway efficiency and capacity and keep the transportation machine going.

To get ideal results, therefore, each side must have a real regard for the interests of the other. Common courtesy and good judgment must be exercised by both parties. Both the sales managers of railway supply companies and the railroad officers should emphasize this to their subordinates.

III

TROUBLE GETTING THE ORDER

It has seemed to me that the supplyman's reception in the railroad man's office has usually been based on courtesy and an endeavor to conserve the supplyman's time as much as the railroad man's. The very few deviations from this which I have heard of are of such small consequence that they do not need to be considered. In other words, I do not think the supplyman's position is difficult as far as his reception and use of his time is concerned; the only difficulty I have found is "getting the order."

IV

"HOT ALL OVER"

There are a few officials who evidently feel that supplymen enjoy "warming their heels" in the outer office and proceed to let them wait there until they are "hot all over." There is no question in my mind but that the most satisfactory arrangement is the setting aside of certain hours for the reception of visitors, and to see, except in extreme in-

stances, that supplymen are promptly received during such hours.

I have in mind one railway mechanical department official who has a card in his outer office announcing that visitors will be received during certain hours. It is seldom possible for an interview during this reception period owing to committee meetings, dictation and other matters which, it would appear, could just as well be taken care of at other than the time set aside for supplymen.

I am not losing sight of the fact that a few of the supply fraternity feel that as long as they are cordially received, it is necessary to talk on every conceivable topic and to continue until the subject shows signs of uneasiness. This practice tends to keep others waiting unnecessarily, and should be discouraged.

V

REMEMBER RAILROAD OFFICERS ARE BUSY MEN

I feel that the blame for what might be considered improper treatment of the supplyman lies almost always entirely with the supplymen. Where this condition does not apply directly, it does indirectly; that is, discourteous treatment may sometimes be meted out where it is undeserved by reason of familiarity with and impositions that have been made upon a railway man by some other untactful supplyman.

I have never experienced any difficulty in obtaining an audience with any railway man with whom I have had any business to transact, nor have I experienced any difficulty in transacting business with the man after I obtained the audience. I have had difficulty, and could have imagined myself discourteously treated, when I have attempted to take up a busy railroad man's time with discussions of the weather and the war.

Further, I have always found when I had any business to transact in any of the railroad offices, that the man upon whom I was calling gave me the impression that he had business to transact with me, and we were able to arrive at a *fair* settlement of the question without difficulty. A fair settlement does not mean that it was always settled entirely my way, but that concessions were often made on both sides.

VI

CHIEF CLERKS AT FAULT

First, I believe a great deal of delay is caused to supplymen by chief clerks and their assistants not promptly advising the railway official of the supplyman's presence and desire to see him. I have often noticed a supplyman who is not so well acquainted, go into an office, and the chief clerk will say, "How do you do?" take his card and continue dictating letters or continue other matters for thirty minutes, or even longer, before taking his card in to the official. I have seen this done when I knew the official would have seen the man immediately upon receipt of his card.

Second: Another cause of delay is that some railroad officials do not seem to realise that a supplyman usually has a great many calls to make in a day, and after making an appointment with a supplyman, he does not make a memorandum of it or make any effort to be prompt, although they expect a supplyman to be "Johnny on the spot."

There is no doubt but that railroad officials have to look over a great many devices and hear a great many talks which are not and cannot be interesting to them; I believe this occasions their getting into the habit of listening with their mind on other matters and not giving the supplyman's talk the attention and consideration deserved. This results in reducing the efficiency of the supplyman, and when he sees he is not being given the proper attention he wastes a great deal of additional time in going over the matter the second time, trying to get his attention.

A great many offices have certain hours for visitors. While this works out very nicely for the railroad men you will readily appreciate that if every railroad official, for instance, set the hours from 10 to 3 for calls, the supplyman would only have a three- or four-hour day at the most.

VII

SUPPLYMAN, STUDY YOURSELF!

I firmly believe that I hit the nail on the head when I state that the criticism mentioned in your letter is very largely due to salesmen who are not temperamentally fit for the position of salesmen; and, secondly, salesmen offering for sale to the railroads a product which in actual practice has not the real merit which the salesman has convinced himself it has.

In all lines of trade you will find men in various capacities who are unsuited for the particular jobs they fill. In all lines of trade you will also find the disgruntled man who has not made a success of anything he has undertaken. And, generally speaking, the reason for his non-success is that he does not sufficiently understand his own temperament or the work that he has undertaken.

This type of man does not lay the blame on himself, where it should rest, but, on the other hand, blames other factors which he imagines are working against him, and which factors generally are entirely of his own making, although he does not recognize his own responsibility in working against himself, the psychology of the human mind being very largely responsible for his imaginary troubles.

If my diagnosis is correct, in order to reach a solution of the question referred to in your letter should not the matter be approached from a different angle? For the salesman to look within himself and endeavor to correct what is wrong there, would be more to the point than to try to correct a practice that may not exist. The salesman should then be certain that his material is mechanically correct and that it answers a demand.

VIII

AUTOCRATIC OFFICE BOYS

Assuming that the supplyman is a competent, experienced person, selected on account of his qualifications and experience, it should be conceded that he will appreciate the fact that the railway officer is a busy man and is often called away from his office to attend to the administrative features of his position, which would indicate that many important matters await his attention when he arrives at his office after a trip, and it is, therefore, not desirable to be interrupted by callers. The experienced supplyman will make due allowance for these conditions and conduct himself accordingly. However, inasmuch as the supplyman represents a company handling materials, the use of which is beneficial to the railroad company, he should be given opportunities for inspection and observation of his materials in use in a manner that will be beneficial to the railroad.

Considerable improvement could be made if there was a more prompt response to his approach by the use of his calling card. In many instances the chief clerk to the railway officer, if he has the authority and support of his chief, could arrange for this courtesy to the supplyman, thus giving him the opportunities he requires without any appreciable delay. In cases where it is necessary for the supply men to have a personal interview with the officer in charge a considerable saving in time for the supplyman could be effected by giving him an opportunity for a few minutes' conversation, during which he would present his case as quickly as possible.

Doubtless, there are some instances where the supply man is given a reasonably early opportunity to make a prompt and graphic presentation of his subject, but in the majority of cases he is compelled to wait a considerable

length of time at the mercy of the autocratic office boy before he is admitted to the office, which causes him serious inconvenience and delay in covering the territory contemplated by his company. In some cases the railroad officer does not give consideration to the delay and expense incident to the supplyman being compelled to wait over another day for an appointment.

IX

EXPERIENCE IN PURCHASING DEPARTMENT

When one considers the immense amount of work that goes through the purchasing department, in some instances consisting of a vast amount of detail which requires constant supervision and watchfulness, one cannot help but feel that he is receiving quite a little consideration to be given a hearing, even allowing that the calls are made during the specified hours set aside for the reception of visitors.

You will appreciate the fact that where there are several callers in the reception room, all waiting to see the purchasing agent, it might appear a long time until the turn for the seventh man came around. No doubt when the victim happens to be No. 7 or No. 8, as the case may be, in successive calls on the same day or week in different places, the time lost is considerable, but if one will note the time given to each individual one cannot help but arrive at the conclusion that the purchasing department is handling the visitors, on their individual calls, as expeditiously as possible. My remarks are based on my experience in the position of No. 7, and sometimes No. 10 or No. 11, and so rarely have I had reason to find fault with the lack of courtesy or consideration, that I feel as though it is a negligible quantity.

X

DON'T BE OVERBEARING

In our line of work, my duties require me to visit perhaps all of the mechanical officials on all of the Eastern railroads, also a large number of transportation officials, and, in a large number of instances, I regard these officials, not only as business acquaintances, but as personal friends, and am so regarded by them. I find that by adapting myself to circumstances which present themselves on each individual railroad which I visit, using patience, and not being overbearing, but courteous, that I am treated in about the same manner by the other fellow.

XI

OBJECTS TO WARMING A CHAIR

As a salesman, I believe in my product, and having made a study of its application, I start out to introduce it where I know it can be used to advantage and where I would adopt it myself, if I were the official in authority. I may have become over-enthusiastic regarding my own devices; but I am the average railway supplyman, and would not be handling them unless I were sure of their merits.

Frank and open discussion will bring out the merits or demerits not only of my own, but of my competitors' products. I may not be able to convince the railroad man and land an order; but if we are the right kind of humans, we both profit by such discussion. To be turned down without an opportunity of fairly presenting the proposition on its merits is unfair to all concerned. I realize, of course, that it takes time to see the supplymen as they come, and that there are many important things to be done; but how better can a man improve his time than by familiarizing himself with worth-while devices which will tend to increase efficiency and economy?

Could we properly conduct our business by correspondence, the frequent calls of the supplymen would not be necessary, and the time of both railroad and supplyman would be conserved. It is a fact, however, that the supplyman must go out and carry his own message; because letters and literature do not bring about the desired results. Selling letters containing most interesting and valuable information usually remain unanswered, and it is very seldom that any serious attempt is made by the railroad man to come back with a letter, discussing the various points or giving real reasons for not being interested. The railroad man makes it necessary for the supplyman to call on him, and should grant an audience. If the railroad man is busy, and it is not convenient for an immediate interview, let him say so and make an appointment for some other time. He should not keep the supplyman warming a chair outside for an indefinite period, and then tell him he is not interested and too busy to discuss the subject.

XII

"BULLDOZING" THE SUPPLYMAN

Our experience has been that it depends considerably on the calibre of the railway officer as to how supplymen are received in railway offices. There are many small calibre men filling big men's shoes. As an experience of this, we might mention an incident with a man in charge of the purchasing for one of the largest railroad systems in the country, formerly, until recent years, noted for its efficiency through the management at that time in charge of the system.

We received the usual form of inquiry for certain products such as we manufacture, and quoted price on our machines with a delivery which, at that time, was practically from stock. We followed it up, and a short time after called on the individual referred to, after seeing those in charge of the mechanical department who had approved our equipment and advised that our machines had been specified by their shop superintendents.

The reception we received from the individual was a very disagreeable one, and of a bulldozing nature, the whole trend of the conversation and abuse being the question of price. I listened until he finished with telling me that he had already placed the order with another manufacturer at a very much cheaper figure. We were positive the construction of the competitive machine was of a design which we had made many years before, and abandoned after experiment as being unmechanical, and we readily convinced their engineering and efficiency departments of this.

After the individual referred to had finished his tirade, we asked him if the business of that railroad was conducted on the basis of price, and if every one in his organization was hired because he was cheap, regardless of whether he had any ability or qualities that justified paying more to get results. I asked if he had investigated our machines, relative to the difference in price, and he said that he had not, that our price was higher than the other people's, and that he did not care to discuss the proposition further.

XIII.

SUPPLYMEN AT FAULT

Based on personal observation, I know that there are railway supplymen who do not fully recognize the fact that the railway man's time is valuable, and who believe that the proper attitude toward the average railway man is one of patronizing interest. I do not say that there is not room for improvement in the way the railway officers receive railway supplymen. I believe, however, that there is greater room for improvement on the part of the railway supplymen than there is for improvement on the part of the railway officers.

XIV

SORE, BECAUSE OF LOST ORDER

We hear complaints from supplymen as to how they are handled by railway men whom they are attempting to sell, but we believe if you trace this down you will find in 99 per cent of the cases the supplyman criticises the railway man who does not purchase his article.

NEW LOCOMOTIVE ORDERS IN 1917

A Total of 7,642 for Both Domestic and Foreign Deliveries—The Largest Number in Seventeen Years

THE number of locomotives ordered in 1917, according to the figures compiled by the Railway Age, was the largest for the last 17 years. The orders totalled 7,642 locomotives, including foreign and domestic, large and small locomotives of all kinds. The output of locomotives as distinguished from orders placed during the same period was 5,446. This was not the largest production in the last 17 years but it has been exceeded only three times in that period, namely, in 1905, in 1906 and in 1907.

Table I, giving the orders for the year in detail, shows that they were divided as follows: Domestic, 2,704; for the United States Government for service with the American troops in France 2,057, and for foreign countries 2,881.

TABLE I—THE LOCOMOTIVE ORDERS IN 1917

Domestic—Including railroads and industrials in the United States and Canada:		
From builders	2,056	
From company shops	648	
Total domestic		2,704
United States Government:		
For service overseas		2,057
England	275	
France	140	
Russia	2,196*	
Other foreign	270	
Total foreign		2,881*
Total of all orders		7,642*

*Including the Russian orders for 1,500 locomotives now held in abeyance.

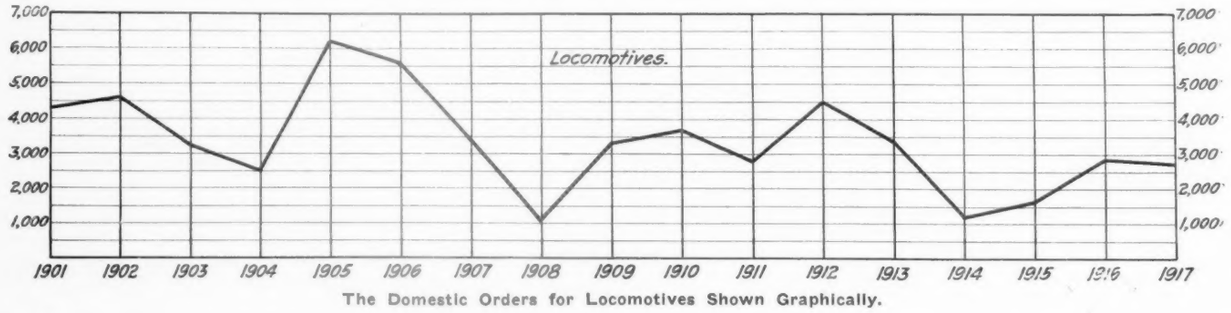
The domestic total, as will be seen from Table II, was considerably below the average for the last 16 years. For a time during the early months of 1917 it seemed as if the orders might exceed those for 1916, but our going into the war, the difficulty of getting material, the high prices and the delays in deliveries resulting from the priority given to orders for the United States Government locomotives and those for our allies, served as a decisive check on the domestic market. The outstanding development during the year, says the Railway Age, was the government orders placed by the department of which Samuel M. Felton, director general of the American railways in France, is the head. These orders totaled 2,057, including 980 locomotives, weighing from 60 to 63 tons, a number of smaller and in most cases narrow gage steam locomotives and a very large number of narrow gage gasoline locomotives ranging from 4 to 23 tons in weight.

TABLE II—DOMESTIC ORDERS FOR LOCOMOTIVES SINCE 1901

Year	Locomotives	Year	Locomotives
1901	4,340	1910	3,787
1902	4,665	1911	2,850
1903	3,283	1912	4,515
1904	2,538	1913	3,467
1905	6,265	1914	1,265
1906	5,642	1915	1,612
1907	3,482	1916	2,910
1908	1,182	1917	2,704
1909	3,350		

The foreign orders for locomotives totaled 2,881 as compared with 2,983 in 1916. The 1916 figures did, it is true, include 350 seven-ton gasoline locomotives for the Russian government which brought the 1916 orders on a tonnage basis down considerably. The 1917 figures, however, as will be noted from Table I, include the 1,500 Russian Decapod locomotives which have been held in abeyance. These orders were distributed last November, 750 to the American Locomotive Company and 750 to the Baldwin Locomotive Works.

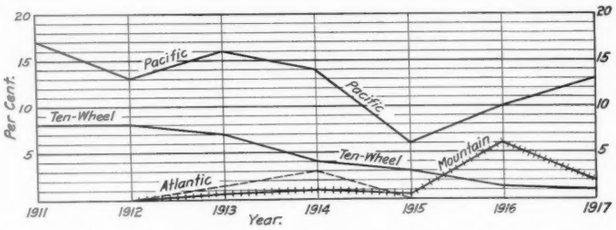
Orders were not definitely signed but arrangements were



The Domestic Orders for Locomotives Shown Graphically.

made on the shop schedule to take care of the locomotives, and priority was given for them over locomotives ordered by American railways last May or March. They have now been put back on the shop programs but they have not been canceled and may yet be built.

These Russian orders, as a whole, comments the Railway Age, have proved at once a blessing and a curse for the American railway supply field and through it for the railways. The first Russian order for locomotives placed in June, 1915, when orders were scarcer than they had been at any time for the preceding six or seven years, was received



The Pacific, Mountain, Atlantic and Ten-Wheel Locomotives Shown in Per Cents of the Total Domestic Locomotives Ordered.

with something closely akin to joyfulness, and so were the others immediately following. The last two orders, that for 500 placed last July and that for 1,500 mentioned in the preceding paragraph, have simply had to be looked upon as an unwelcome duty, as something that America as one of the opponents of Kaiserism has been properly called upon to do for one of its brother opponents. But it is still true that these Russian orders were given priority over engines urgently needed for transportation requirements at home and with all the English, French, Russian and American government engines which were placed, the American orders were pretty well down on the builders' lists.

The locomotive situation since the holding up of the Russian orders has accordingly taken on a brighter aspect. The

TABLE III—CLASSIFICATION OF DOMESTIC LOCOMOTIVES ORDERED 1911-1917

	1917	1916	1915	1914	1913	1912	1911
Mikado	834	754	562	333	796	1,309	590
Switching—							
Eight-wheel	110						
Six-wheel	282	730	221	201	638	821	443
Four-wheel	47						
Consolidation	60	63	194	166	823	858	577
Mallet	175	218	120	59	72	168	112
Pacific	342	278	102	174	566	594	486
Santa Fe	370	325	75	63	...	...	...
Ten-wheel	28	40	39	48	255	364	238
Mogul	13	28	12	24	42	61	127
Mountain or Mohawk	55	182	9	12	24	...	2
Atlantic	...	2	1	34	46	5	9
American	...	1	1	19	8	8	27
Electric	43	32	69	59	94	75	133
Other	188	238	168	73	103	252	406
Total	2,704	2,891	1,573	1,265	3,467	4,515	2,850

Russian order for 500 locomotives placed in July, 1917, is now almost completed, some of the locomotives having been shipped and others which were prepared for shipment are being stored. In fact, arrangements have recently been made whereby 200 of the Russian locomotives will be remodeled and leased temporarily to a number of American roads at a rental of $50 a day. With the other 1,500 locomotives being held in abeyance, the American railroads can now look forward to receiving in the near future the power they put on order six months or a year ago, and specialty manufacturers have already received notification to ship the specialties for these orders.

The situation as to the orders placed by the United States government for service with the American troops in France has had much more to commend it than the Russian orders. Deliveries on the War Department orders have been better spaced, with regard, of course, to the shipping situation. But even some of these locomotives will also be made available. Thirty have recently been loaned to the Pennsylvania, the Lehigh Valley, the Philadelphia & Reading and the Baltimore & Ohio, and arrangements are being made for the use of about 100 in all. But what has counted most on these orders has been the standardization and the fact that standardization began at the first stage of the game. Railway and supply men alike, reading the accounts of the delays over the standardization of the Liberty motor, the Liberty truck, the Enfield rifle, the Browning gun, the ships, have expressed their relief that in one industry at least the War Department was represented by a man who could take an instrument of warfare, in this case, a locomotive, and have it turned out, ready for shipment and a stand-

TABLE IV—THE LOCOMOTIVES BUILT

1917

Domestic	2,586
Foreign	2,861
Total	5,446

IN PREVIOUS YEARS

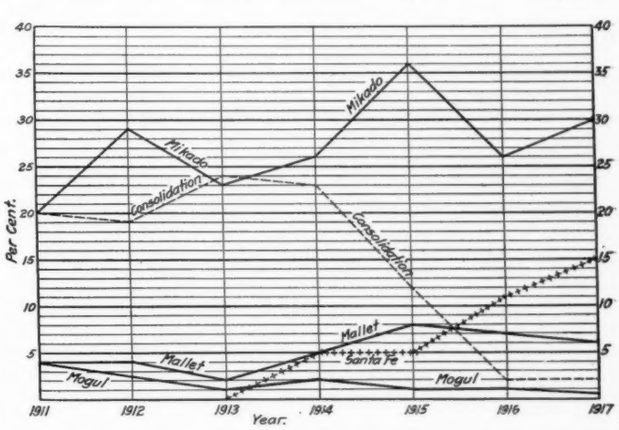
Year	Locomotives	Year	Locomotives
1899	2,475	1908*	2,342
1900	3,153	1909*	2,887
1901	3,384	1910*	4,755
1902	4,070	1911*	3,530
1903	5,152	1912†	4,915
1904	3,441	1913†	5,332
1905*	5,491	1914†	2,235
1906*	6,952	1915†	2,085
1907*	7,362	1916†	4,075

*Includes Canadian output.
†Includes Canadian output and equipment built in railroad shops.

ard for a year's future production in 20 working days. As a result these U. S. A. Consolidation locomotives are keeping out of the way in the builders' plants and locomotives for American roads now have a clear path to completion and shipment.

THE DOMESTIC ORDERS

When the extraordinary conditions of the locomotive market, both as to prices and deliveries, existing during the greater part of 1917 are considered, there is nothing unexpected in a falling off in the number of orders placed for locomotives for domestic use during 1917 as compared



The Mikado, Santa Fe, Mallet, Consolidation and Mogul Type Locomotives Shown Graphically in Per Cents of the Total Domestic Locomotives Ordered.

with 1916. The significance of this reduction so far as it applies to the railroads, however, is more apparent than real. The reduction has taken place largely in the number of locomotives ordered for industrial use and the lighter types for railroad service. There is an actual increase in the number of locomotives of several of the heavier types for which orders have been placed. The falling off of available tractive

effort is, therefore, much less real than the figures for the total number of locomotives ordered would indicate.

Enough has been said, however, to indicate that the situation as to domestic orders during the past year has been bad. Builders and specialty manufacturers alike have been postponing orders periodically and railway men have had to be pacified with the information that deliveries have been held up for them on account of more urgent war orders. This situation is now being remedied, so that the outlook both for deliveries and production in 1918 looks exceedingly favorable. Whether additional orders will be placed in the next few months is a question. The fact that the government has taken over the railroads is looked upon favorably, and with the easing up in prices and the improved deliveries, the supply field is confidently expecting a large buying movement. Upholding this belief is the fact that many railroads have reserved space for the coming year. The Norfolk & Western's order for the Mallet locomotives reported this week in part takes advantage of such a reservation and the New York Central has had a reservation of space for 250 locomotives with the American Locomotive Company since last September.

In the detailed lists of orders given in the Railway Age will be found many orders of more than ordinary importance, very large orders having been placed by a considerable number of roads. Companies which placed orders for 40 or more locomotives were as follows:

Atchison, Topeka & Santa Fe, 130; Buffalo, Rochester & Pittsburgh, 55; Canadian Government Railways, 120; Chicago & North Western, 70; Chicago, Burlington & Quincy, 65; Great Northern, 90; Illinois Central, 154; Lehigh Valley, 61; Louisville & Nashville, 48; New York, New Haven & Hartford, 61; New York Central and associated lines, 150; Norfolk & Western, 51 (all of which were heavy Mallets); Northern Pacific, 65; the Pennsylvania Railroad, Lines East, 503; Pennsylvania Lines West, 100; Philadelphia & Reading, 65; South Pacific System, 130, and Union Pacific System, 100.

As far as the domestic orders are concerned it will be noted from Table III and the diagrams that there have been, even with the smaller total of orders placed, increases in the number of Mikado, Pacific and Santa Fe locomotives. The Decapod, a new development in domestic locomotive design, has increased in favor as indicated by its adoption by the Canadian Pacific and the Pennsylvania for heavy freight service. The number of Mallet locomotives shows, on the other hand, a decrease. There is also a considerable drop in the number of Mountain and Mohawk locomotives ordered, but this is merely the result of the New York Central's not having ordered any additional engines of this type since its big contracts for these locomotives last year. The most noticeable decrease in any one kind of locomotives was in switching locomotives; indeed the larger part of the decrease in the total is to be found in the light locomotives for railroads and industrial companies.

Of the steam locomotives ordered for railroad service in this country, that is excluding locomotives ordered for industrial or logging purposes, about 94 per cent were specified to be equipped with superheaters and approximately 80 per cent to be equipped with brick arches.

Special valve gears have been specified on 422 locomotives including 327 Baker, 90 Southern, and 5 Young. Mechanical stokers have been specified for 615 locomotives, including 133 Street, 337 Duplex, 100 Crawford, 30 Standard and 15 Elvin. The last is a new stoker which has just been put on the market this year.

The Freight Car Orders in 1917

The Total of 164,058 Compares With 205,368 in 1916—Domestic Orders Reached New Low Level

THE orders for freight cars in 1917, according to the annual statistical tabulations of the Railway Age, totaled 164,058, including 79,367 for domestic use; 18,844 for the United States war department for the American forces in France; 180 other cars for the United States government and 64,667 for export to France, Russia and other foreign countries. These figures are a considerable reduction from the totals for 1916 when 205,368 cars were ordered. The decrease is all to be found in the orders for domestic use, there having been an increase from 35,314 in 1916 to 64,667 in the foreign orders and the entirely new factor of orders for our own government. In fact, the domestic orders for 79,367 in 1917 compare with 170,054 in 1916 and are the lowest since the Railway Age began its compilations in 1901, with the exception of one year, 1908, when only 62,669 cars were ordered. The foreign figures, however, must not be taken at their full face value because they include 30,500 Russian cars, orders for which have been held in abeyance.

The passenger cars ordered total 1,167, including 1,124 for domestic uses, this figure also being one of the smallest since the Railway Age began its compilations in 1901.

Of freight cars ordered in 1917 about 43 per cent were for foreign delivery either for the United States Government or for its Allies. Of the orders for 79,367 cars placed by the railways in this country for domestic use about 21,000, or 27 per cent, were ordered to be built by the railways themselves. In number this slightly exceeds those ordered to be built in company shops last year, but in percentage of total cars ordered, the ratio is about double that of last year.

The shop orders were placed during the early part of the year when the prices and deliveries of the builders were at their worst. Even with this large number of shop cars and the shortage of steel there were a much smaller number of the all-wood construction cars ordered than would be expected.

Of the nearly 80,000 cars ordered only about 5,000, or 6.2 per cent, were all-wood cars. This is in about the same proportion as last year and the figures for both years are of course much larger than the immediate previous years. As steel for the underframes became more available during the year less all-wood cars were ordered.

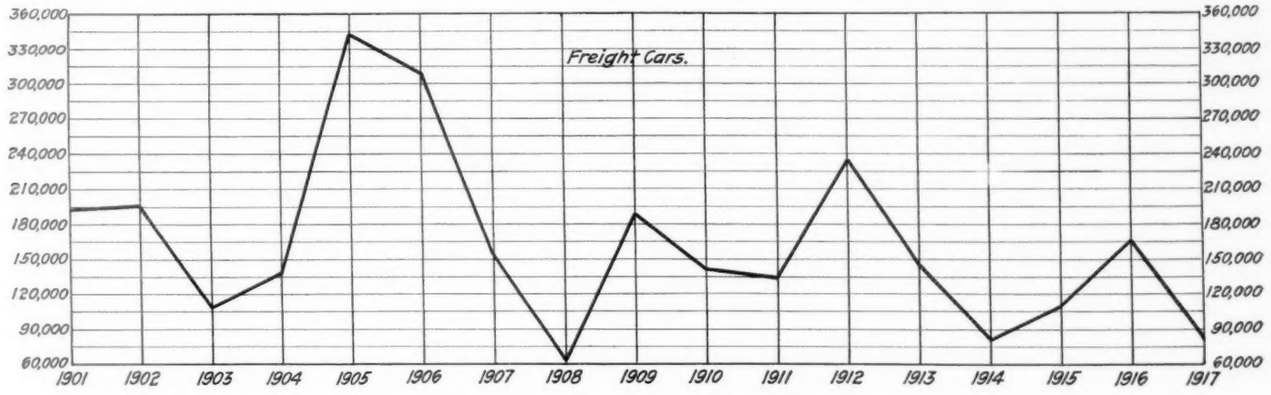
Of all the cars ordered there was a proportionate decrease in box and hopper cars and a proportionate increase in refrigerator, gondola, flat and tank cars over the preceding years. The proportion of all-steel, steel underframes and other kinds of equipment remained practically the same.

The freight car situation during the year has not been exactly favorable either with the railways or the builders, the prices having been so high that the railways have not dared to come into the markets. As a result the builders have been operating in some cases at as low as 50 or even 25 per cent of capacity and as one manufacturer has put it, "when there were orders there was a shortage of labor and material, or when there was material, a shortage of labor."

The United States Government orders for the forces in France have helped the situation considerably and it is to the credit of the authorities at Washington that the deliveries on these cars have been called for with full regard to both the shipping situation and to the situation in car builders' establishments.

The Russian orders for cars have not had anything like the effect on the car market that the Russian locomotives orders have had. There have not been large car orders placed and there were not sufficient domestic orders to establish a conflict between deliveries on domestic and on Russian requirements, as was the case for locomotives, as mentioned elsewhere in this issue.

While 1917 may not have been exceedingly bright from the standpoint of freight car orders, the situation as to the immediate future is exactly the opposite. The opportunities for the railways to obtain cars were never better than at present. With the material situation much better than it was last year at this time and with a smaller number of orders on their books, the car builders are in a position to give from three to four months' delivery, which is the condition in normal times. With a plant capacity of about 25,000 cars per month and with current orders to absorb this capacity for the next three months, one-fourth of which is for foreign delivery, the car companies could, if sufficient orders were placed, organize their forces for maximum full production and provide over 100,000 cars within the next six months. This would assist materially in relieving the car shortage. They have been handicapped throughout the year by the scarcity of labor and the delayed receipt of material. Even now if a large number of cars was ordered for immediate delivery, it might be necessary for the Government to assist in the matter of materials. A shortage of material not only delays the delivery of the cars but disrupts the shop organization and greatly increases the cost of the cars. In other words, the conditions must be stabilized if the car production is to be sufficient to meet the needs of the country for new freight cars.



The Domestic Freight Car Orders Shown Graphically.

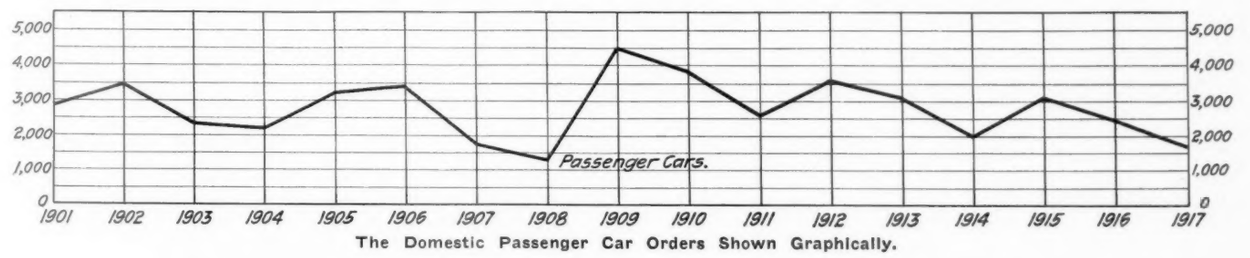
And this still omits from consideration the new developments at Washington, which, as noted editorially, have been received on the whole with favor in the supply field.

There were 151,401 freight cars built during the year, of which 119,363 were for domestic use and 32,038 for foreign delivery. Of the 119,363 for domestic use, 12,273, or over 10 per cent, were of wood and over 11 per cent, or 13,488, were built by the railroads themselves. The total number built is a material increase over 1916 and 1915.

TABLE A—CLASSIFICATION OF FREIGHT CARS ORDERED DURING 1917

	All-steel	Steel frame and St. U. F.	Steel underframe	Steel center sills	Wood	Not Specified	Total
Box	3,253	9,300	3,634	7,902	518	652	25,259
Refrigerator	.....	400	6,889	100	351	.....	7,740
Hopper, including ore	9,737	1,100	86	50	300	.....	11,273
Gondola	5,597	3,925	2,864	2,702	13	104	15,205
Coal (not otherwise specified)	.....	.....	1,095	.....	1	.....	1,096
Stock	.....	.....	1,650	1,100	1,711	1	4,462
Flat	749	.....	142	754	373	128	2,146
Tank	7,842	.....	6	.....	.....	230	8,078
Caboose	217	9	300	50	70	174	820
Miscellaneous or not specified	1,284	.....	666	100	1,096	142	3,288
Total	28,679	14,734	17,332	12,758	4,433	1,431	79,367

The fact that the domestic orders for freight cars were so low, means that there were not many large or important individual orders. Orders for over 2,000 cars were placed by the following roads: Atchison, Topeka & Santa Fe, 2,450; Baltimore & Ohio, 2,450; Canadian Government Railways, 5,870; Chicago & North Western, 2,050; Chicago, Milwaukee & St. Paul 4,130 (nearly all in company



The Domestic Passenger Car Orders Shown Graphically.

shops); Illinois Central, 2,575; Northern Pacific, 2,000; Pacific Fruit Express, 2,700; Pennsylvania Lines East, 4,329; Philadelphia & Reading, 2,230; Southern Pacific System, 5,443; Union Pacific System, 3,594, and the Union Tank Line, 2,200. The Western Maryland placed orders for 1,900 cars.

With all the decrease in car production and orders, the types of cars built during the year were not devoid of interesting features in their design. There has been produced an all-steel refrigerator car, and 85-ton capacity car with five hoppers, a 120-ton capacity coal car, a new type of self-propelled motor car and notable examples of steel passenger cars.

The all-steel refrigerator car was built by the Pennsylvania and is particularly interesting. The superstructure is virtually a shell within a shell, the inner lining being self-sustaining and separated from the outside lining by four continuous layers of insulation extending from side sill to side sill over the top of the inner steel wall in one continuous piece. The cars are provided with basket bunkers, an insulated solid bulkhead and the space between the bulkheads is divided into three compartments. The Baltimore & Ohio and the Michigan Central have built refrigerator cars which are particularly well insulated, the insulation being applied solid instead of with the usual intervening air spaces. These cars have the basket ice bunker with the solid bulkhead.

The Virginian 120-ton capacity coal car marks a most important step in the construction of this type of equipment. It is provided with the Lewis articulated six-wheel truck having a wheel base of 9 ft. The car weighs 73,900 lb. and with 10 per cent overload has a ratio of revenue load to total load of 76.4 per cent. It represents a design which has been given the most careful study, and contains many interesting features. The Pennsylvania 85-ton capacity hopper car, with five hoppers, has a light weight of 60,000 lb. and a gross cubical capacity of 3,228 cu. ft. as against 4,422 cu. ft., the maximum cubical capacity of the Virginian car is also noteworthy.

Among the passenger cars those built for the Delaware & Hudson and for the Erie represent real progress in the design of all-steel passenger equipment. The Delaware & Hudson cars are 72 ft. 8¼ in. long over body end sills, they weigh 138,700 lb. and have a seating capacity for 90 passengers. The Erie cars are interesting on account of the ingenious construction of the superstructure. The distribution of metal is such that a stiff construction has been obtained with a saving in weight. These cars are 70 ft. long over the body end sills; they weigh 110,900 lb. and have a seating capacity for 76 people, including 12 seats in a smoking compartment.

The prospects for improvements in design during the coming year are promising, particularly in freight cars. With the heavy demand for freight equipment new cars will be built and every means will be taken to get them promptly. With private and corporate interests being held subordinate to the nation's needs, the "standard car" will receive more serious consideration. A committee of the American Railway Association has been working on this problem for some time. Sample cars have been built and much study has been given the question. The committee has been unable as yet to come to an agreement. It is extremely desirable that the matter be settled as promptly as possible so that the designs can be used for the large amount of new equipment which must be constructed in record time during the current year.

ELECTRIC SOLDERING IRON.—A new type of soldering iron consists essentially of two high-resistance heating points, or electrodes, that become incandescent when the current passes through them. As the circuit is closed as soon as the points come into contact with the metal to be heated, the iron is said to become heated to the required degree the moment it touches the work. Besides, the heat is generated at the point of contact and at the spot where the heat is needed when soldering, brazing, or annealing. The iron operates at from six to sixteen volts and the points are made to carry current according to ratings of 150, 250, and 500 watts.—*Machinery.*

TABLE I—THE FREIGHT CAR ORDERS IN 1917

Domestic—Including railroads and private car lines in the United States and Canada:		
From builders	58,443	
From company shops	20,924	
Total domestic		79,367
United States Government:		
For service overseas	18,844	
For use in this country	180	
Total United States Government		19,024
France	21,700	
Russia	42,500*	
Other foreign	1,467	
Total foreign		64,667*
Total of all orders		164,058*

*Including the 30,500 Russian cars, orders for which are held in abeyance.

TABLE II—THE PASSENGER CAR ORDERS IN 1917.

Domestic:	
From builders	1,005
From company shops	119
Total domestic	1,124
U. S. Government	6
Foreign	37
	1,167

TABLE III—DOMESTIC ORDERS FOR CARS SINCE 1901

	Freight Cars.	Passenger Cars.		Freight Cars.	Passenger Cars.
1901	193,439	2,879	1909	189,360	4,514
1902	195,248	3,459	1910	141,024	3,881
1903	108,936	2,310	1911	133,117	2,623
1904	136,561	2,213	1912	234,758	3,642
1905	341,315	3,289	1913	146,732	3,179
1906	310,315	3,402	1914	80,264	2,002
1907	151,711	1,791	1915	109,792	3,101
1908	62,669	1,319	1916	170,054	2,544
				Freight Cars.	Passenger Cars.
1917				79,367	1,167

TABLE IV—THE FREIGHT AND PASSENGER CARS BUILT IN 1917.

	Freight cars	Passenger cars
Domestic	119,363	1,969
Foreign	32,038	31
Total	151,401	2,000
All-steel	61,115	1,874
Steel frame	29,310	.....
Steel underframe	40,386	93
Steel center sills	8,317	.....
Wood	12,273	33
	151,401	2,000

COMPARISON WITH PREVIOUS YEARS

Year	Freight cars	Passenger cars
1899	119,886	1,305
1900	115,631	1,636
1901	136,950	2,055
1902	162,599	1,948
1903	153,195	2,007
1904	60,806	2,144
1905*	165,155	2,551
1906*	240,503	3,167
1907*	284,188	5,457
1908*	76,555	1,716
1909*	93,570	2,849
1910*	180,945	4,412
1911*	72,161	4,246
1912†	152,429	3,060
1913†	207,684	3,296
1914†	104,541	3,691
1915†	74,112	1,949
1916†	135,001	1,839

*Includes Canadian output.
†Includes Canadian output and equipment built in railroad shops.

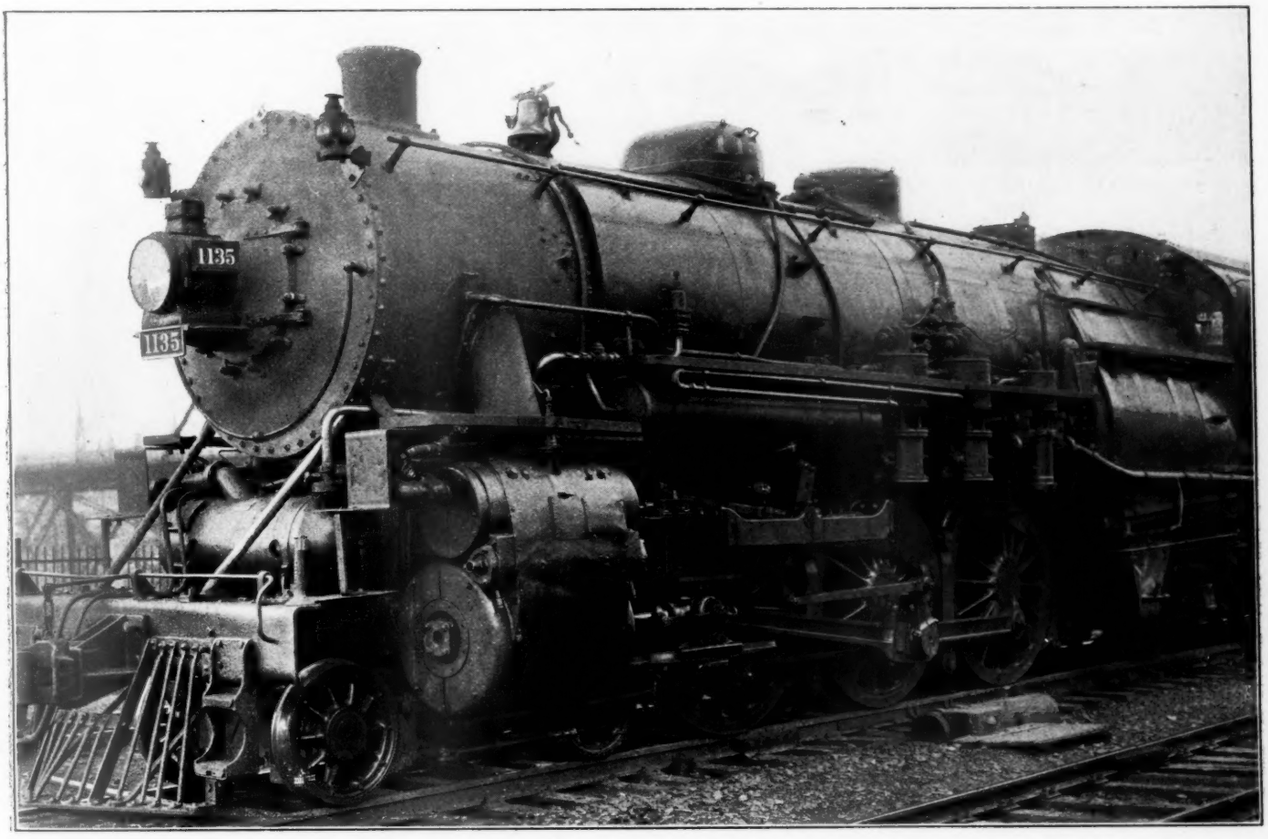
LOCOMOTIVE FEEDWATER HEATING

There are probably but few roads in this country that have not experimented to a greater or lesser degree with some form of locomotive feedwater heater in an endeavor to reclaim some of the vast amount of heat that is liberated from a locomotive. One of the most tried methods is that of condensing the exhaust steam from the air compressor in a coil in the tank. This has been successful only as the engine crew has been able to keep the temperature of the tank water below the point at which it can be lifted by the suction of the injector. Obviously greater difficulty is experienced with this method of feedwater heating in the warm weather and the economies gained are much less than in the cold weather. When the water becomes too hot to be lifted by the injector, the difficulties are readily appreciated.

Other methods that have been tried consist of utilizing and conserving the hot gases in the smokebox. Experiments have been made with various types of smokebox or waste gas heaters, but none have yet been developed to any great degree of success. One great disadvantage of the smokebox or waste gas feedwater heater is the large amount of heating surface required to raise the temperature of the feedwater any appreciable amount. This complicates the front end design and materially increases maintenance problems.

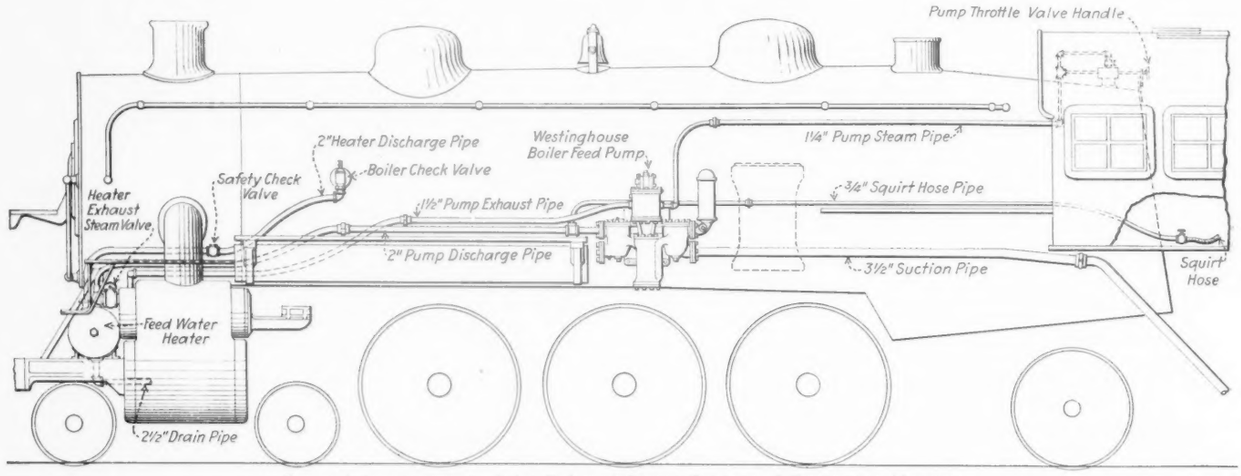
Of the waste heat passing out of the stack, that contained in the steam exhausted from the cylinders is three times that contained in the exhaust gases. Furthermore, much more heat per unit of volume is contained in the exhaust steam than in the exhaust gases, which makes the exhaust steam the more desirable, as a smaller amount of heating surface will be required for the same temperature rise in the feedwater than were the exhaust gases used.

The system developed by the Locomotive Feed Water Heater Company, New York, uses the exhaust steam method of heating the water, the steam being taken directly from



Application of Feedwater Heater and Steam Pump to a Locomotive

the steam chest or the exhaust passage in the cylinder saddle, as shown in the illustrations. The amount of exhaust steam taken is not sufficient to interfere materially with the drafting of the locomotive, but a sufficient amount is taken to raise the feedwater temperature from 150 to 180 deg. The heater is located somewhere near the cylinders in order to reduce the length of passages between the cylinders and the heater. In the particular case illustrated, it is located



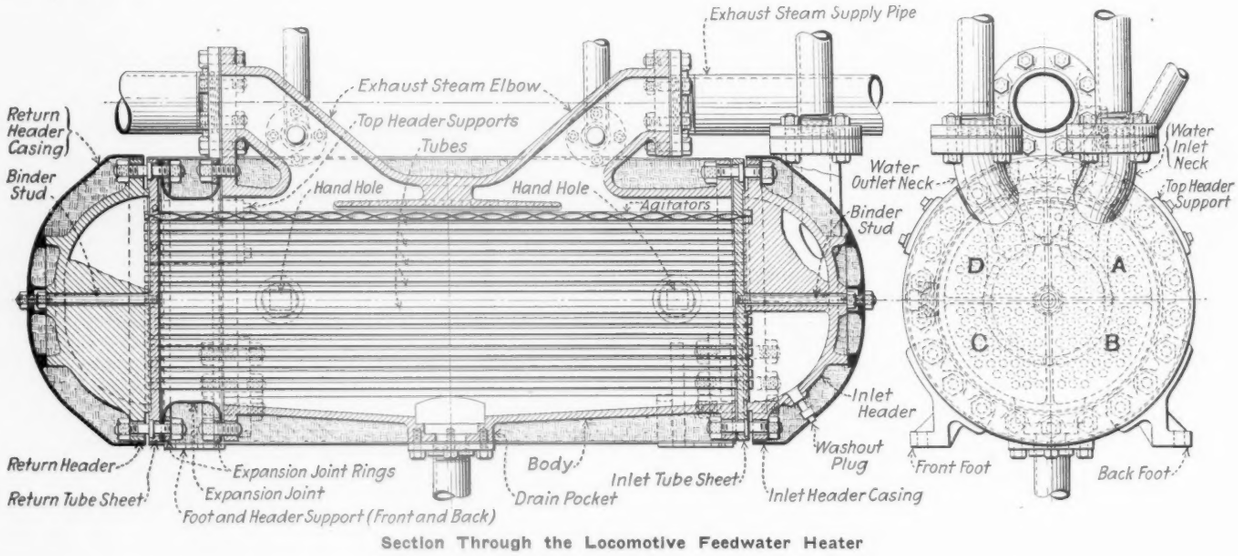
General Arrangement of An Exhaust Steam System of Feedwater Heating

directly in front of the cylinders. Pipes extend from each steam chest to the inlet connections of the heater. With this system the injector is replaced by an entirely new water pump which was developed for this particular work by the Westinghouse Air Brake Company. It may be located on either side of the locomotive, being applied in a manner similar to the application of an air compressor.

The diagrammatic view of the arrangement of the feedwater heating equipment applied to a locomotive well illustrates the system. The pump draws the water from the tank through a 3½-in. suction pipe and delivers it to the heater through a 2-in. pipe. From the heater the water passes through a 2-in. pipe with a check valve to the boiler check. A ¾-in. connection is made in the pump discharge pipe for the squirt hose, thus providing cold water for that purpose. The pump takes steam from the cab turret and the speed of the pump is regulated by a valve at that point. The exhaust steam from the pump passes into the heater to give up its waste heat to the feed water. The exhaust steam condensed in the heater passes through an opening in the bottom of the heater to a drain pipe that carries it to a point near the ash pan where it is drained to the track.

The pump was modeled after a Westinghouse compressor. The steam end is that used on a standard 9½-in. compressor. The water cylinder is 6½ in. in diameter and is double acting. When running at 80 strokes a minute the pump will deliver 6,500 gals. per hour. There are ten valves, five suction and five discharge, located in the chambers on each side of the pump. Each set of five valves is included in a valve deck which may be easily removed. Tests made with this pump have shown that 50 lb. of water and over are pumped per pound of steam used for operating the pump.

A sectional view of the heater is shown among the illustrations. As indicated by the notations, the exhaust steam from the steam chests is admitted at the top, allowed to circulate around the tubes which contain the feed water, and passes out through the drain at the bottom. The water from the pump passes through the heater four times before it is delivered to the boiler. This is accomplished by



Section Through the Locomotive Feedwater Heater

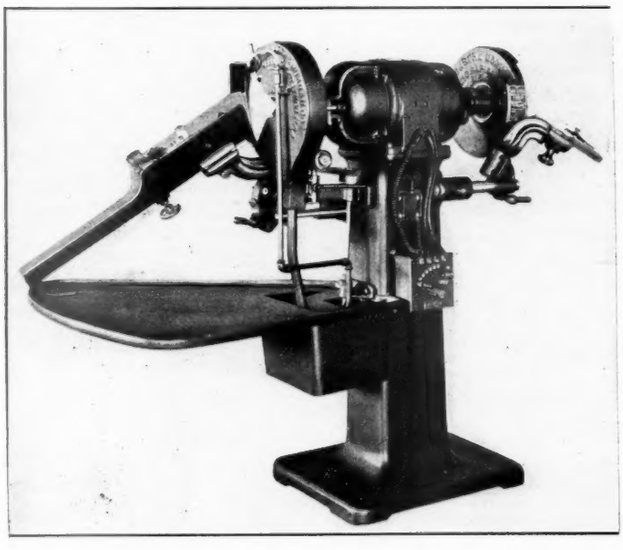
means of walls in the headers at the ends of the heater. The header at the right has three chambers formed by a wall extending horizontally across the header at the center and a vertical wall extending up from this wall. The header at the left has one vertical wall dividing it into two parts. The water enters the header at the right in the upper right hand chamber. It passes through the tubes in quadrant *A* to the header at the left. From there it returns through the tubes marked *B*, then back through the tubes marked *C* to the header at the left, thence through tubes *D* to the water outlet. By thus passing the water through the heater four times an equivalent length of pipe of 16 ft. is obtained from which the water will absorb heat.

One of the most important features of this heater are the agitators contained in each of the tubes in the heater. These are shown in the top row of tubes in the heater illustrated. They consist of a thin brass corrugated and spiraled strip of metal and their function is to so agitate the water as it passes through the tubes that every particle of it will come in contact with the hot tubes and absorb all the heat possible from the exhaust steam on the outside of the tubes. This agitation also serves to keep the tubes clean and free from scale. The higher the velocity of the cold water passing through the tubes the more violent the agitation and the greater the amount of heat absorbed by the water.

Two types of heater bodies are being used, one cast iron and the other steel plate. When a cast iron body is used the difference in expansion of brass and iron is taken up in a copper expansion joint forming one end of the body. When steel plate is used the difference is taken up by a flexible form of joint formed at either end of the body where it connects to the tube sheet.

DRILL GRINDERS

The importance of the correct grinding of drills cannot well be overestimated, especially at the present time when the price of drills is so high, and it is a patriotic duty to economize in the use of everything made of steel. A large



Motor Driven Drill Grinder

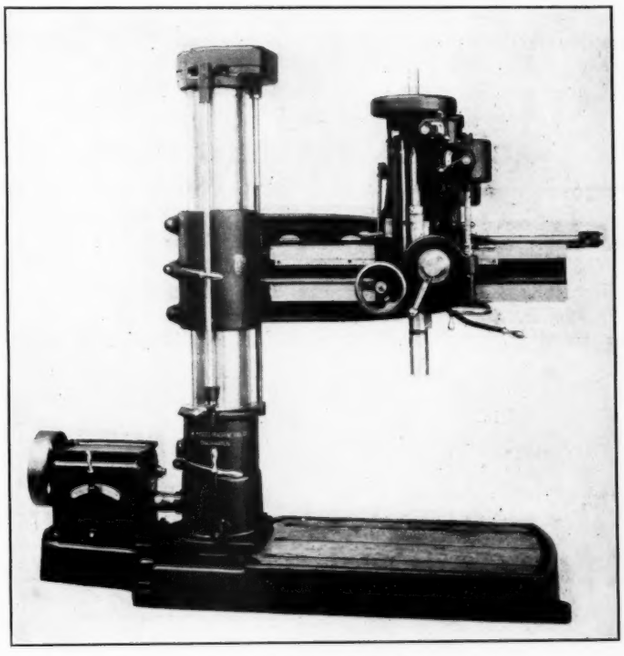
percentage of drill breakage and wear may be charged directly to imperfect grinding, and this detail of shop operation should not be neglected because it is apparently a minor one.

The illustration shows a W. N. L. New Yankee drill grinder made by the Wilmarth & Morman Company, Grand Rapids, Mich., and it has several features which make it of interest to large users of drills. The grinder is motor driven, having a 1-hp. General Electric motor built into the head, and is particularly adapted to railroad work because all sizes of drills may be ground on the same machine. Drills up to ½ in. are ground dry on a fine grained wheel on one side of the machine, and drills from ½ in. up to 3½ in., are ground wet on a coarser wheel located at the other side. No calipering is necessary with this type of grinder. Both lips of the drill are automatically ground to the same length, angle and clearance, and the only adjustment necessary is for the length of the drill.

MORRIS PLAIN RADIAL DRILL

A new 4 ft. plain radial drill has been placed on the market by the Morris Machine Tool Co., Cincinnati, Ohio. The machine will drill to the center of an 8 ft. 6 in. circle. The maximum distance between the spindle and the base is 5 ft. and the maximum distance between the spindle and the table 3 ft. 3 in.

The base of the machine is deep and well ribbed and provides a working surface 3 ft. by 4 ft. 3 in. There is a lubricating channel around the base which is so arranged that an oil pump can be attached if desired. The stump, which



Morris Plain Radial Drill

is securely mounted on the base, runs through to the top of the column. At the top of the stump a combination annular and thrust ball bearing is mounted, which carries the entire weight of the column and the arm. At the bottom of the column there is a plain bearing on the stump. This construction permits the arm and column to swing about the stump with ease.

The arm is moved up and down on the column by power and has safety stops at the extreme positions. The head is heavily constructed with long bearings for the spindle. It travels on the arm on wide bearings and is driven by means of a hand wheel through reduction gears to a rack and pinion. The spindle is 1 15/16 in. in diameter above the sleeve and is equipped with a ball thrust bearing. The spindle speeds range from 19 to 350 r. p. m. Through a feed gear box mounted on the head 6 speeds are obtainable. A direct read-

ing depth gage is provided, arranged to throw the speed out. A safety feed throw-out is also arranged at the end of the spindle travel.

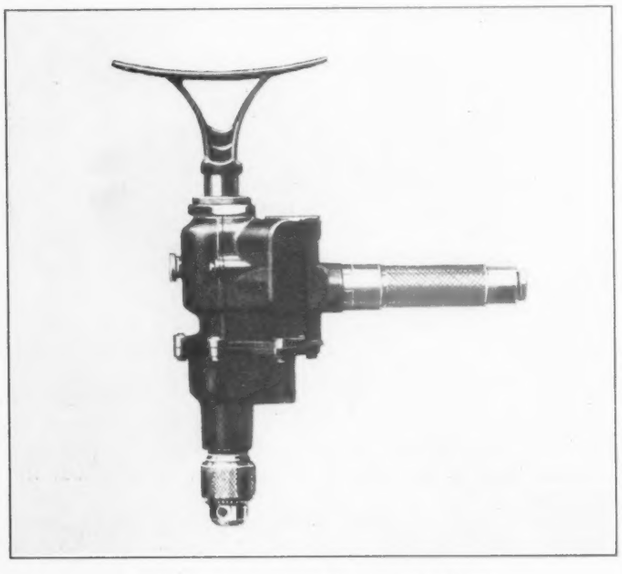
The speed box is fully enclosed and the gear runs in heavy oil. A tool tray is mounted on top of the box. A speed plate is furnished giving the operator all spindle speeds at the various positions of the lever. The lever at the bottom of the stump, standing in a vertical position, controls the friction clutches on the pulley shaft in the speed box. This lever, which is convenient for the operator, in neutral position stops every gear on the machine and in connection with the double back lever on the head, the operator can secure six spindle speeds instantly. With the speed box 18 spindle speeds are available and on the cone pulley drive there are 15 spindle speeds. The double back gear is mounted on the back of the head and is fully enclosed.

All gears are of steel except the spindle gear, which is semi-steel. The back gear clutches and clash gears are made of nickel steel heat treated and hardened. The tapping attachment miter gears are enclosed in an oil-tight case and run in oil. The frictions are of the expanding ring type capable of pulling the maximum capacity of the drill and controlled from the front of the machine. The friction rings are adjustable. The bearings throughout the head are of bronze with felt wipers and a recess around the bearing to act as an oil reservoir.

The machine is regularly furnished with a tight and loose pulley for belt drive, but can also be arranged for drive by cone pulleys and a constant speed motor in connection with a speed box, or for variable speed motor drive.

AIR DRILL FOR LIGHT WORK

The Ingersoll-Rand Company, New York, has recently developed a new light weight high power pneumatic non-reversible drill, especially adapted to drilling holes up to 9/16 in. in diameter and reaming holes up to 5/16 in. in diameter. This new drill has been designated as No. 5 "Little David." It weighs 15 lb. and has a free spindle speed of 1,000 r.p.m. With a drill chuck its over-all length



"Little Giant" Air Drill for Light Work

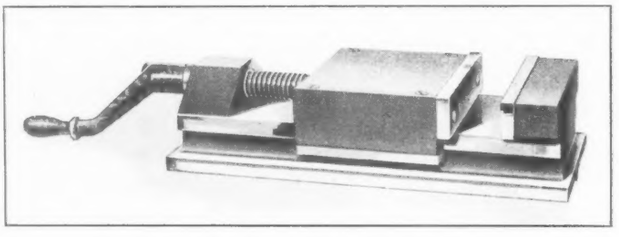
is 14⅝ in. and the distance from the side of the drill to center of spindle is but 1½ in., which facilitates its operation in unhandy places. The spindle is threaded to accommodate either a No. 1 M.T. socket or drill chuck and these may be readily interchanged as desired.

The four-piston motor is simple in construction and the accessibility of the reciprocating parts is of particular advantage. The removal of five cap screws permits the crank shaft assembly to be withdrawn in its entirety. The valve is of the rotary type and is gear driven. Roller bearings are used on the connecting rods and ball bearings on the crankshaft. This drill can be furnished with either a breast plate spade handle or a telescoping feed screw. In the latter case the length of feed measures 2½ in.

A NEW MILLING MACHINE VISE

Milling machine vises can be used in many cases instead or jigs or fixtures and become an efficient addition to the machines, especially when used in pairs. In this way one vise can be loaded or unloaded while the cutters are still working on a job in the other vise. The Cleveland Milling Machine Company, Cleveland, Ohio, has made interchangeable vises, one of which is shown in the illustration, with the tongue slot an exact distance from the face of the solid jaw.

The steel jaws of the vise are as low as is consistent with



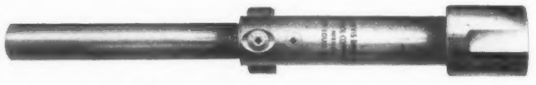
Vise for Milling Machine

strength and may be replaced by special jaws for increasing the range or holding work of irregular shape. Tongue slots are at right angles to each other, so the vise can be held parallel, or at right angles to the spindle, and the screw diameter is made as large as the height of the jaws will allow.

The solid jaw of this vise is made with a special arrangement of cores to prevent it from breaking diagonally from the corner of the solid jaw to the base, due to unequal contraction of the iron in cooling.

DAVIS EXPANSION BORING TOOL

The important part played by boring machines in present railroad shop practice is well known and has resulted in a big demand for boring tools, which are suited to many different kinds of work. The production of turret lathes, boring mills and drill presses will be increased by the use of ex-



Style E Expansion Tool for Turret Lathes

pansion boring tools which are accurate and will stand up under the work. The Davis Boring Tool Company, St. Louis, Mo., has devoted 13 years to the manufacture of this type of tool. The one shown in the illustration is made for turret lathes. The important feature of this tool is the micrometer adjustment for controlling the cutter expansion. This device permits the accurate maintenance of any size within range of expansion, and by compensating for wear, fast feeds and speeds may be used. The pilot is hardened and ground and has oil grooves.

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WE GUARANTEE, that of this issue 8,700 copies were printed; that of these 8,700 copies 7,380 were mailed to regular paid subscribers, 107 were provided for counter and news companies' sales, 324 were mailed to advertisers, 221 were mailed to exchanges and correspondents, and 668 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 8,700, an average of 8,700 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

Following the severe winter weather of last month, the Pennsylvania Railroad sent from its shops at Altoona, to different division points on the road, about 300 men, to repair locomotives.

Thirty locomotives built at the Baldwin Locomotive Works, Philadelphia, for military railroads in France have been ordered by the Government to be put in use on the Philadelphia & Reading, the Pennsylvania, the Baltimore & Ohio, and the Lehigh Valley.

The Atchison, Topeka & Santa Fe, which recently announced that it had granted a 10 per cent bonus for the six months' period just ended to unorganized employees, will pay the bonus in regular monthly installments in the coming year with the regular salaries of the men.

The Chicago, Burlington & Quincy has granted an increase in pay to employees in its car department, effective since December 1. Those paid on a straight hourly basis were granted an advance of 2 cents an hour and men on piece work were given a 5 per cent increase.

The War Department announces that volunteers are now being accepted for a provisional reinforcement railway regiment, for the National army, which is being organized at Camp Grant, Rockford, Ill. Men are wanted who have qualifications in railway construction, operation and maintenance; shop work and transportation. Applications are received at all of the principal recruiting stations.

The car repair shed of the Baltimore & Ohio at Storrs Station, Cincinnati, Ohio, was destroyed by fire on November 27, together with 21 freight cars, eight of them loaded. The structure was of frame construction, 48 ft. by 445 ft., open on the sides and with three tracks running the length of the shed. The fire was discovered in the vicinity of the lockers where the men kept their tools and working clothes. Estimated loss on structure, cars, tools and supplies, $37,000.

The Pennsylvania Railroad has completed arrangements for placing on sale the new war savings stamps and thrift stamps at ticket offices and in its shops, freight stations and in the various departments on the Lines East and West of Pittsburgh. Every ticket agent on the entire system, except those in the immediate vicinity of a post office, will have the stamps for sale. As in the case of the campaign for the two Liberty Loans, special efforts will be made to encourage investment in the savings and thrift stamps on the part of employees. It having been found impracticable to place the stamps on sale directly in the pay cars, arrangements will be made wherever possible to have them on sale near the pay cars when employees are being paid.

The President has approved the recommendation of the War Industries Board that the maximum prices heretofore fixed by the President upon ore, coke, pig iron, steel and steel products, subject to revision on January 1, 1918, be continued in effect until March 31, 1918. New contracts calling for delivery on or after April 1, 1918, must be subject to revision by any authorized United States Government agency, so that deliveries after that date shall not exceed the maximum price then in force, although ordered or contracted for in the meantime.

The western lines, at the request of the Railroads' War Board, agreed to furnish 102 locomotives to the eastern roads. On December 21, 39 had been delivered at Chicago and seven at St. Louis, while 26 were en route at that time and 30 had not yet started for their destination. It was expected that all the engines would be delivered by December 25, except a few which were being transformed from coal to oil burners. The following pro rata plan for providing the locomotives was decided upon at a meeting in Chicago: Atchison, Topeka & Santa Fe, nine; Northwestern, seven; Burlington, seven; Great Western, one; Chicago, Milwaukee & St. Paul, eight; Rock Island, six; Chicago, St. Paul, Minneapolis & Omaha, two; Duluth & Iron Range, ten; Duluth, Missabe & Northern, twelve; Great Northern, five; Illinois Central, six; Kansas City Southern, one; Minneapolis & St. Louis, one; Minneapolis, St. Paul & Sault Ste. Marie, two; Missouri, Kansas & Texas, two; Missouri Pacific, four; Northern Pacific, five; St. Louis-San Francisco, three; Cotton Belt, one; Southern Pacific, six; Union Pacific, four.

Tank Car Tests and Safety Appliances

The executive committee of the Master Car Builders' Association has issued a circular regarding the hydrostatic tests of tanks of tank cars, stating: "That part of section 23 of the standard specifications for tank cars, classes I, II, III and IV, which requires that the tanks be retested hydraulically at stated intervals, is hereby suspended as to tanks for which such tests shall become due prior to January 1, 1920, except when the cars are shopped for repairs. The

requirements of section 23 of each of the specifications named, that new tanks shall be tested before being put into service, and that tanks damaged to the extent of requiring patching or renewal of one or more sheets, or extensive riveting or recalking of seams, shall be retested before being returned to service, are not suspended."

A circular was also issued regarding safety appliances, stating: "The date effective of rule 3, paragraph (m) of the rules of interchange, regarding the interchange of cars not equipped with United States safety appliances or United States safety appliances, standard, is hereby extended from January 1, 1918, to March 1, 1918.

Headlight Order Modified

In view of the pressure upon the railroads for cars and engines to move war materials, the Interstate Commerce Commission has postponed the effective date of its order requiring locomotives to be equipped with high power headlights from January 1 to July 1 as to all new locomotives placed in service. For locomotives in service prior to that date the changes required are to be made the first time locomotives are shopped for general or heavy repairs after July 1, 1918, and all locomotives must be so equipped before July 1, 1920.

Grand Trunk Safety Bulletin

The safety engineer of the Grand Trunk, in his December bulletin (No. 15), illustrates one of his chief points by a picture of a barrel tipping over the brink of Niagara Falls. In this connection he says:

"Would you go over Niagara Falls in a barrel? *I should say not.* That's a funny question to put into a safety bulletin. What are you driving at anyway? *Just this:* Scores of you men every day are taking chances that are just as unnecessary, just as foolish and just about as risky as going over Niagara Falls in a barrel, and if you could read the reports in my office showing how Grand Trunk men get injured and killed, you would agree with me."

The safety engineer finds that three causes alone are responsible for more deaths to Grand Trunk men than all other causes combined: (1) Run over by cars or engines; (2) Falling from cars or engines; (3) Train or yard men working on cars which are moved by another engine working on the same track.

Railway Regiments' Tobacco Fund

Interest in the Railway Regiments' Tobacco Fund has extended to several associations during the past month, the Railway Business Association announcing that it will donate $1,000 to the fund from the proceeds of its annual dinner. On the motion of Daniel A. Brady, the New York Railroad Club voted to give $250 to the fund, $250 to the Y. M. C. A., $250 to the Red Cross and $250 to the Knights of Columbus. The Machinery Club of New York City at a recent board meeting approved a resolution that appropriated one-third of the profits of the cigar department for the month of December for soldiers' smokes, one-half of this amount to be sent to the New York Sun Tobacco Fund and the other half to the Railway Regiments' Tobacco Fund. A contribution of $17 was also received from the Signal Appliance Association.

Since the last report in the December number of the *Railway Mechanical Engineer,* contributions have been received from the following supply companies:

American Car & Foundry Company, New York (contribution)	$50
Robert H. Blackall, Pittsburgh, Pa.	10 a month for 12 months
J. Alexander Brown, New York	10 a month
Bridgeport Machine Tool Co., Rochester, N. Y.	10 a month for 12 months
Corning Glass Works, Corning, N. Y. (contribution)	120
Damascus Brake Beam Company, Cleveland, Ohio (contribution)	25
Dayton Malleable Iron Company, Dayton, Ohio	10 a month
Marion Malleable Iron Works, Marion, Ind.	10 a month
Railroad Water & Coal Handling Company, Chicago	5 a month for 12 months
Rodger Ballast Car Company, Chicago	10 a month
Standard Safety Nut Corporation, New York	25 to cover six months

It is expected that the second shipment of tobacco will go forward about January 15.

MEETINGS AND CONVENTIONS

No June Mechanical Conventions.—At the meeting of the executive committees of the Master Car Builders and the American Railway Master Mechanics' Associations in New York December 20, it was decided in view of the present state of affairs to hold no convention in June, 1918. If conditions warrant, however, a business meeting may be held in Chicago sometime during the year.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

Air Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railway Master Tinners', Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind. Convention postponed.

American Railway Master Mechanics' Association.—J. W. Taylor, Karpen Bldg., Chicago. Convention postponed.

American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago. Convention postponed.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Second Monday in month, except June, July and August, Hotel Morrison, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. R. McMunn, New York Central, Albany, N. Y. Convention postponed.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio. Convention postponed.

International Railway Fuel Association.—J. G. Crawford, 547 W. Jackson Blvd., Chicago.

International Railway General Foremen's Association.—William Hall, 1126 W. Broadway, Winona, Minn. Convention postponed.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention postponed.

Master Car Builders' Association.—J. W. Taylor, Karpen Bldg., Chicago. Convention postponed.

Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass. Convention postponed.

Niagara Frontier Car Men's Association.—E. N. Frankenberger, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, New York Telephone Bldg., Buffalo, N. Y.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio. Convention postponed.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio. Next meeting, September 10, 1918, Chicago.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Jan. 8, 1918	Methods of Conserving Fuel	T. Britt	James Powell	P. O. Box 7, St. Lambert, Que.
Central	Jan. 10 1918	What Constitutes the Equipment Department and Advantages Offered Young Men for Advancement; Annual Meeting, Election of Officers, Etc.	F. W. Brazier	Harry D. Vought.	95 Liberty St., New York.
Cincinnati	Feb. 12, 1918			H. Boutet	101 Carew Bldg., Cincinnati, Ohio.
New England	Jan. 8, 1918	Internal Strains on Steel Rails	James Howard	W. E. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Jan. 18, 1918	Activities of the National Association of Corporation Schools	F. C. Henderschott	Harry D. Vought.	95 Liberty St., New York.
Pittsburgh	Jan. 25, 1918			J. B. Anderson	207 Penn. Station, Pittsburgh, Pa.
St. Louis	Jan. 11, 1918			B. W. Frauenthal.	Union Station, St. Louis, Mo.
Western	Jan. 21, 1918	Organization Maintenance	A. R. Ayers	Joseph W. Taylor.	1112 Karpen Building, Chicago.

PERSONAL MENTION

GENERAL

R. C. BEAVER has been appointed assistant mechanical engineer of the Bessemer & Lake Erie, with office at Greenville, Pa.

JOHN BENZIES, road foreman of equipment of the Chicago, Rock Island & Pacific, at Trenton, Mo., has been appointed supervisor of fuel economy of the Chicago Terminal, Illinois, and Missouri divisions, with headquarters at Rock Island, Ill.

W. H. BOOTH, road foreman of equipment of the Chicago, Rock Island & Pacific, at El Dorado, Ark., has been appointed supervisor of fuel of the Louisiana, Arkansas and Indian Territory divisions, with headquarters at Little Rock, Ark.

H. CLEWER, master mechanic of the Chicago, Rock Island & Pacific at Trenton, Mo., has been appointed superintendent of fuel economy, with headquarters at Chicago. His duties in this position include the supervision of the use of fuel, locomotive supplies, lubricating materials and general features in connection with the efficiency of locomotive operation.

F. CONNOLLY, road foreman of equipment of the Chicago, Rock Island & Pacific at Herington, Kan., has been appointed supervisor of fuel economy of the St. Louis, the Kansas City Terminal, the Kansas and the El Paso divisions, with headquarters at Herington, Kan.

J. L. CURRY, road foreman of equipment of the Chicago, Rock Island & Pacific, at El Reno, Okla., has been appointed supervisor of fuel economy on the Oklahoma and Pan Handle divisions of the Chicago, Rock Island & Pacific, and also of the Southern and Amarillo divisions of the Chicago, Rock Island & Gulf, with headquarters at El Reno, Okla.

J. H. EDWARDS, electrical foreman of the Chicago, Rock Island & Pacific, has been appointed supervisor of stationary plants, with headquarters at Chicago, with supervision over stationary plants and pumping stations.

J. R. JACKSON, assistant engineer of tests of the Atchison, Topeka & Santa Fe, Chicago, has received a commission as captain in the ordnance department of the United States Army.

C. F. LUDINGTON, superintendent of the fuel department of the Missouri, Kansas & Texas, has been appointed fuel supervisor of the Chicago, Milwaukee & St. Paul, with office in Chicago.

F. MEREDITH, road foreman of equipment of the Chicago, Rock Island & Pacific, at Silvis, Ill., has been appointed supervisor of fuel economy of the Iowa, Nebraska and Colorado divisions, with headquarters at Fairbury, Neb.

EDWARD S. PEARCE, whose appointment as mechanical engineer of the Cleveland, Cincinnati, Chicago & St. Louis, with office at Beech Grove, Ind., was announced in the December *Railway Mechanical Engineer*, graduated from the mechanical engineering course at Purdue University and was first employed in the maintenance of way and mechanical departments of the Norfolk & Western. From June, 1913, to January, 1914, he was employed in the machinery department of Joseph T. Ryerson & Sons, Chicago. On the latter date he entered the service of the New York Central Lines West as a special engineer in the office of the chief mechanical engineer at Chicago, where he remained until June, 1914, when he was transferred in the same capacity to the office of the superintendent of motive power of the Cleveland, Cincinnati, Chicago & St. Louis. In April, 1916, he was promoted to assistant mechanical engineer and in January, 1917, he was again promoted to special engineer in the office of the general superintendent of the transportation department, which position he held until December 1, when his appointment as mechanical engineer became effective.

C. C. RICHARDSON has been appointed assistant to the superintendent of motive power of the Bessemer & Lake Erie, having supervision of the office, accounting and stores departments. His office is at Greenville, Pa.

H. R. WARNOCK, superintendent of motive power of the Western Maryland at Hagerstown, Md., has been appointed general superintendent of motive power of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago, succeeding A. E. Manchester, deceased. Mr. Warnock was born at Newcastle, Pa., on July 16, 1870. He began railway work as a freight brakeman with the Pennsylvania Lines West of Pittsburgh in June, 1889, and later in the same year went to the Pittsburgh & Lake Erie as a brakeman. In September, 1891, he was promoted to locomotive fireman and later was locomotive engineer, which position he held until May, 1900. From that date until July, 1904, he served consecutively as engine despatcher, roundhouse foreman, and general foreman, resigning on the latter date to become master mechanic of the West Side Belt, Pittsburgh, Pa., where he remained until October, 1905, when he became master mechanic of the Monongahela Railroad. He remained in this position until September, 1913, when he was appointed superintendent of motive power of the Western Maryland, which position he held until his appointment as noted above, which became effective on December 15.

H. R. Warnock

W. E. RICKETSON, mechanical engineer of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Beech Grove, Ind., has been appointed chief of the equipment divisions, valuation department of the New York Central Lines, with headquarters at New York, taking the place made vacant by the death of Mr. Buchanan last February. Mr. Ricketson was graduated from Cornell University in 1907, with degree of M. E. and began railway work in 1903 with the Delaware & Hudson Company, for which company he worked during his summer vacations while attending college. From 1907 to 1910 he was special apprentice with the Lake Shore & Michigan Southern, and the following two years successively was roundhouse foreman of the Lake Erie, Alliance & Wheeling at Alliance, Ohio, and the Lake Shore & Michigan Southern at Ashtabula. He was then general foreman of the latter road at Youngstown, Ohio, until September, 1913, when he was appointed assistant mechanical engineer of the Cleveland, Cincinnati, Chicago & St. Louis. On March 1, 1914, he was promoted to mechanical engineer, which position he held until his recent appointment as chief of the equipment division, valuation department, of the New York Central Lines, as above noted.

P. Smith, assistant engineer of fuel economy of the Chicago, Rock Island & Pacific, has been appointed supervisor of fuel economy on the Cedar Rapids, Minnesota, Dakota and Des Moines divisions, with headquarters at Cedar Rapids, Iowa.

C. L. Tuttle has been appointed mechanical engineer of the Bessemer & Lake Erie, with headquarters at Greenville, Pa.

H. D. Webster, mechanical engineer of the Bessemer & Lake Erie, has been appointed engineer of motive power, with headquarters at Greenville, Pa. The organization of the maintenance of equipment department of the Bessemer & Lake Erie was subdivided on January 1, the locomotive department being under the direct supervision of Mr. Webster.

G. F. Wieseckel, master mechanic of the Western Maryland, with office at Hagerstown, Md., has been appointed superintendent of motive power, with headquarters at Hagerstown, succeeding H. R. Warnock, resigned to go to another company.

F. W. Wilson, engineer of fuel economy of the Chicago, Rock Island & Pacific, has been appointed chief fuel inspector, reporting to the fuel agent.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

Thomas Allison has been appointed road foreman of engines on the Pasco division, of the Northern Pacific, with headquarters at Pasco, Wash., succeeding C. A. Wirth, promoted.

J. K. Booth, general foreman of the Bessemer & Lake Erie, with office at Greenville, Pa., has been appointed master mechanic, with supervision over the locomotive department shops at Greenville.

Albert J. Davis, assistant to the master mechanic of the Erie at Hornell, N. Y., has been appointed master mechanic of the Allegheny and Bradford divisions, with headquarters at Hornell.

L. E. Dix, master mechanic of the Trans-Mississippi terminal, a subsidiary of the Texas & Pacific, has had his jurisdiction extended over the Lousiana division of the Texas & Pacific, from New Orleans, La., to Boyce, with headquarters at Gouldboro, La. J. A. Delaney, whose transfer to Big Springs, Tex., was mentioned in these columns last month, was master mechanic of this division.

W. J. Eddy, superintendent of fuel economy of the Chicago, Rock Island & Pacific, with headquarters at Chicago, has been appointed master mechanic at El Dorado, Ark.

Harry J. Freund has been appointed traveling fireman of the Central Railroad of New Jersey.

Timothy F. Gorman, formerly general foreman of the Erie at Brier Hill, Youngstown, Ohio, has been appointed master mechanic of the Meadville division, with office at Meadville, Pa.

W. D. Hitchcock has been appointed master mechanic of the Albuquerque division of the Atchison, Topeka & Santa Fe, with headquarters at Winslow, Ariz., succeeding M. Weber, transferred.

J. S. Motherwell, master mechanic of the Louisiana & North West, with office at Horner, La., has been appointed master mechanic of the Oklahoma, New Mexico & Pacific, with office at Ardmore, Okla.

R. H. Nicholas, general foreman of the Central of New Jersey at Communipaw (N. J.) engine terminal, has been appointed assistant master mechanic.

Charles T. Sugars has been appointed master mechanic of the Louisiana & North West, with office at Homer, La., succeeding J. S. Motherwell, resigned.

John R. Tunison has been appointed traveling fireman of the Central Railroad of New Jersey.

J. H. Weston has been appointed road foreman of engines on the Minnesota division of the Northern Pacific, with headquarters at Staples, Minn., succeeding M. S. Montgomery, resigned.

SHOP AND ENGINEHOUSE

Thomas J. Cole, master mechanic of the Erie at Meadville, Pa., has been appointed shop superintendent at Meadville.

J. S. Hardwick, boiler foreman of the Gulf, Colorado & Santa Fe at Galveston, Tex., resigned that position to become a boilermaker at the United States navy yard at Norfolk, Va., and was promoted soon after to chief planner of the boiler construction progress department.

W. E. Hardy, foreman of the Central Railroad of New Jersey, at East Twenty-second street, Bayonne, N. J., has been promoted to general foreman of the engine terminal at Communipaw, N. J., succeeding R. H. Nicholas.

Lee R. Laizure, master mechanic of the Erie at Hornell, N. Y., has been appointed shop superintendent at Hornell.

CAR DEPARTMENT

J. B. Conerly has been appointed master car builder of the Missouri, Kansas & Texas with office at Denison, Tex.

R. D. Wilson has been appointed assistant chief car inspector of the Central Railroad of New Jersey, with office at Jersey City, N. J.

Paul S. Winter has been appointed general car foreman of the Bessemer & Lake Erie, with supervision over the car department shops at Greenville, Pa. Mr. Winter was born on April 15, 1884, at Denver, Colo. He attended a manual training school in Denver and secured his first railroad position on June 6, 1901, with the Denver & Rio Grande. He entered the service of the Bessemer & Lake Erie in June, 1903, as a machinist, was transferred to the drafting room in February, 1908, and to the car department in July, 1913.

PURCHASING AND STOREKEEPING

F. W. Taylor has been appointed purchasing agent of the Southern Pacific, with headquarters at San Francisco, Cal., to succeed I. O. Rhoades, retired. Mr. Taylor was born at Campo Bello, New Brunswick, on August 5, 1867. He entered the service of the Union Pacific in December, 1885, as clerk in the store department at Laramie, Wyo., where he remained until July, 1889, when he was transferred in the same capacity to Pocatello, Idaho, with the division storekeeper of the Union Pacific, the Oregon Short Line and the Southern Pacific lines east of Sparks, Nev., remaining until January, 1911, when he was appointed general purchasing agent of the Pacific Electric, the Peninsula, Stockholm Electric, the Fresno Traction and the Visalia Electric at Los Angeles, Cal., which position he held until the time of his appointment noted above.

OBITUARY

Thomas A. Ayres, assistant purchasing agent of the Erie with office at New York, died on December 9, at his home in Ridgewood, N. J., at the age of 38.

John H. Orchard, foreman car repairs of the Delaware & Hudson at Carbondale, Pa., died on December 5, 1917. He was 62 years old, and from early boyhood was connected with the car repair shops of the Delaware & Hudson.

SUPPLY TRADE NOTES

H. G. Doran & Co., Chicago, has been appointed agent for the Rivet Cutting Gun Company, Cincinnati, Ohio.

J. H. Sharp has been appointed western representative of the Glazier Manufacturing Company, with headquarters at the McCormick building, Chicago.

A. A. Strom, vice-president of the Pettibone-Mulliken Company and president of the U. S. Ball Bearing Company, died in New York on November 29. Mr. Strom was born in Sweden in 1855. He came to this country at the age of 14 and worked in the foundries of N. S. Bouton & Co. at Chicago. He started a small forge shop in Chicago in 1880 with P. A. Godey, at first working at the forge himself. The business increased rapidly and in 1885 it was incorporated under the name of Strom Manufacturing Company. This business was later incorporated with Pettibone-Mulliken Company, with which Mr. Strom had been associated ever since. At his death he was a director and vice-president of that corporation and also president of the U. S. Ball Bearing Manufacturing Company.

A. A. Strom

F. S. Wilcoxen, who for the past nine years has been mechanical representative for the Pilliod Company, New York, has resigned and has accepted a position with the Perolin Railway Service Company as special representative. Mr. Wilcoxen commenced his mechanical career with the Pennsylvania Company at Wellsville, Ohio. He has served as locomotive fireman and engineer on the C. C. and S. Ry. (now a part of the Wheeling & Lake Erie), also as locomotive engineer and roundhouse foreman on the Alabama Great Southern Railway at Birmingham, Ala., and with the Toledo, St. Louis & Western Railway as locomotive engineer, road foreman of engines, general foreman and division master mechanic. He assumes his duties as special representative of the Perolin Railway Service Company on January 15.

F. S. Wilcoxen

L. S. Love has resigned as sales manager of the Sherritt & Stoer Company, Philadelphia, to become general manager of the Machine Tool Engineering Company, Singer building, New York.

The Greaves-Klusman Tool Company, Cincinnati, Ohio, has purchased the building formerly occupied by the Champion Tool Works and will use it as an erecting plant in addition to its present works.

F. H. Bird, traveling engineer of the American Steel Foundries, Chicago, has received a commission as first lieutenant in the ordnance department of the United States army, and is now stationed at Dayton, Ohio.

Peter Leidenger, western sales manager of the Dayton Manufacturing Company, Dayton, Ohio, died suddenly of pneumonia at the Buckingham Hotel, St. Louis, Mo., on December 28. Mr. Leidenger was born at Ironton, Ohio, in 1862, and had been with the Dayton Manufacturing Company for the past 30 years.

New Glidden Company Formed

One of the most important transactions in the annals of the paint and varnish trade of this country has just been concluded by the outright purchase of the Glidden Varnish Company, of Cleveland, Ohio, and its subsidiary, the Glidden Varnish Company, Ltd., of Toronto, Canada, by a newly formed corporation headed by Adrian D. Joyce, who was until recently director and general manager of sales and distribution of the Sherwin-Williams Company. The new company will be known as the Glidden Company, and is capitalized at $2,500,000, fully paid in.

A. D. Joyce

Associated with Mr. Joyce are O. A. Hasse, formerly manager of paint and varnish sales for the Sherwin-Williams Company, and R. H. Horsburgh, controller of the same company. They will assume the positions of vice-president and secretary-treasurer, respectively, in the new corporation. All three have resigned their connections with the Sherwin-Williams Company, and it is positively stated that the new company is not in any way connected with other paint and varnish interests.

O. A. Hasse

Members of the Glidden family, including F. A. Glidden, heretofore president of the company, will retire from the new corporation, but the balance of the organization will remain intact and will be enlarged as necessity demands.

The present Glidden plant, occupying nearly 17 acres, is a model in completeness of equipment and modern arrangement. With present extension plans completed the company will be the largest varnish plant in the country.

The Glidden Varnish Company has been in business nearly

50 years. Railroad and steamship companies are among the largest Glidden customers. Many large government contracts will be executed by the new company.

Adrian D. Joyce has been 20 years in the paint and varnish business, mostly with the Sherwin-Williams Company. He was for several years a traveling salesman, later special representative for the Industrial Trade, then sales manager of the Kansas City district and finally assistant sales manager of the company in Cleveland. He was then advanced to general manager of sales and distribution. He has had a broad sales and executive experience, and had charge of all sales and warehouse direction. He has been closely identified with national and international affairs in the paint and varnish trade, and is experienced in manufacturing. He has paid particular attention to raw materials and studied specially the new uses of paint and varnish materials. He was a director of the Sherwin-Williams Company.

R. H. Horsburgh

O. A. Hasse's entire experience has been in the paint and varnish business. He started in the advertising department, then served as secretary and finally was transferred to sales department in charge of sales, serving consecutively in the following departments: insecticides, insulating varnish, railroad, street railroad and marine finishes, also general manufacturing sales, and then for several years he was manager of paint and varnish sales. He has had experience as a traveling salesman, and is familiar with the sales and manufcturing problems, having had at one time entire charge of the development of railway sales. He has also made a deep study of raw materials.

R. H. Horsburgh was with the Sherwin-Williams Company for 18 years, starting as office boy and working up to controller. In this latter position he was in charge of credits, accounts, taxes and insurance. He was in close touch with the financing of the company, was a credit specialist and has spent his entire career in this industry.

The Union Railway Equipment Company, Chicago, has purchased the exclusive rights to manufacture and sell the Bourell brine valve or retainer formerly handled by the Western Sales Company, Chicago.

J. E. Buckingham, formerly northwestern representative of the Standard Steel Works Company with offices in the Northwest Bank building, Portland, Ore., is now assistant general manager of the Hofius Steel & Equipment Company, Seattle.

The Union Supply Company, Chicago, Ill., has opened a branch office in the Call building, San Francisco, Cal., in charge of A. A. Dawley, western representative. Mr. Dawley was formerly purchasing agent of the Denver & Salt Lake at Denver, Colo.

Oscar F. Ostby, 2736 Grand Central Terminal, New York, has been appointed sales representative for the White American Locomotive Sander Company, Roanoke, Va., for territory from Baltimore north to the Canadian border, and west as far as Pittsburgh and Cleveland.

N. B. Payne has opened an office in the Havemeyer building, 25 Church street, New York, as an electric crane specialist dealing in new and used traveling cranes. Mr. Payne was formerly associated with Manning, Maxwell & Moore, Inc., New York, and has an extensive experience in this kind of work.

J. M. Hopkins, president of the Camel Company of Chicago, became chairman of the board of directors on January 1, and was succeeded as president by P. M. Elliott, formerly vice-president. W. W. Darrow, formerly general manager, is now vice-president, and A. B. Wegener, general manager of sales, has been made secretary.

D. Gleisen has been appointed manager of the industrial bearings division of the Hyatt Roller Bearing Company, Newark, N. J. Mr. Gleisen is a mechanical engineer, a graduate of Stevens Institute, and has been connected with the Hyatt Roller Bearing Company for the past six years. He was formerly assistant manager of the Hyatt Company in charge of the bushings sales.

J. W. White has been appointed manager of the power and railway division of the Detroit office of the Westinghouse Electric & Manufacturing Company. Mr. White was formerly connected with the Pittsburgh office of the company, subsequently becoming associated with the Allis Chalmers Company, and has now returned to the Westinghouse Company, assuming the position above noted.

CATALOGUES

Reclaimed Machinery.—The Prest-O-Lite Company, Inc., Indianapolis, Ind., has issued a pamphlet entitled "Turning Waste Into Profit." It contains 82 illustrations and shows the possibilities of reclaiming broken and worn machinery by the oxy-acetylene process.

Gas Furnaces.—Tate-Jones & Co., Inc., Pittsburgh, Pa., has issued Bulletin No. 160 describing its recuperative gas oven furnaces. A series of exhaustive tests show an important saving in fuel of as high as 50 per cent, due to the recuperative feature. Twenty per cent saving over the old type of furnace is guaranteed, a fact which is of importance with the present high price of fuel.

Du Pont Products.—There has just been issued a handy little booklet which contains a list of all the products manufactured by the E. I. du Pont de Nemours and Associated Companies, namely, Du Pont Chemical Works, Du Pont Fabrikoid Company, The Arlington Company, and Harrisons, Inc.

Journal Boxes.—The National Malleable Castings Company, Cleveland, Ohio, has issued circular No. 69 describing the National coiled spring journal box. The two features of this box are a positive coil spring action to close the cover, and steel inserts in the pedestal guides to improve wearing qualities. Circular No. 70 by the same company describes an ingenious and simple train pipe hanger and clamp.

Pressed Steel Trucks.—The Pressed Steel Truck Company of Pittsburgh, Pa., has recently issued folders describing the Atlas two-wheel and four-wheel trucks. These folders are well illustrated and show in some detail the interesting features of construction and describe the various uses to which these trucks may be put. They are constructed with a one-piece frame, without bolts or rivets. They weigh less than wooden trucks and have greater strength. The axles are supported on flexible hardened steel bearings.

NEW SHOPS

Santa Fe Lines.—The Atchison, Topeka & Santa Fe is building additional repair shops at Ottawa, Kan., at a cost of about $60,000. Swanson Brothers Contracting Company, Topeka, Kan., has the contract for the work.